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THE 12-IN. AMERICAN-MADE GUN was fired for the first time at Sandy Hook on July 24. The powder was found to be unsatisfactory. The gun was discharged 5 times with reduced charge and weight of projectile. It is designed for a 1,000-lb. shot, 440 lbs. of powder and a resulting velocity of 1,950 ft. per second. With this service charge the pressure in the chamber of the new gun should not exceed 16.5 tons per sq. in. The actual test projectile weighed 850 lbs., the heaviest powder charge was 370 lbs., and the velocity of 1,920 ft. per second was due to the lighter projectile. The pressure developed, however, was 16 tons. Further trials are postponed until better and slower-burning powder can be secured.

AN ARMOR-PLATE INGOT 80 ins. wide and 23 ins. thick and weighing 32,000 lbs. has just been cast by Carnegie, Phipps & Co., at Homestead, Pa. It was successfully cast in a sand mold for a test of a new process.

THE P. & R. R. R. TERMINAL STATION in Philadelphia, is to be 266 ft. × 305 ft. in plan, built of stone and iron. The train shed will be 96 ft. high with a span of 266 ft., all in iron and steel, covering 13 tracks. The plans of the new depot are made by Wilson Bros. & Co., of Philadelphia.

SAVANNAH, GA., WANTS A 26-FT. CHANNEL, and an appropriation of $3,000,000 in a lump to construct it. Capt. CARTER, U. S. Engineer, says that the plans for this channel have been adopted, and the government is committed to the expenditure of the sum named. The effort is now being made by the citizens and railways to obtain this amount in one installment instead of in driblets extending over years. The present commerce of Savannah amounts to $153,000,000 per annum, and a strong movement is to be made to force the necessary action from Congress.

THE CHICAGO DRAINAGE COMMISSION has fixed upon a route for the canal between Chicago and the Summit, and has decided to issue $5,000,000 of 5% bonds.

THE PINTSCH GAS BUOYS are to be tried on the Lakes. The last civil sundry appropriation bill authorized the Lighthouse Board to purchase 15 gas buoys at $2,000 each, and 6 of these are to be shortly furnished by the Safety Car Heating & Lighting Co., of New York, who represent the Pintsch system in America. Two of these will probably be located at the Lake Huron entrance to the St. Clair River, and the others on dangerous reefs in the Lakes.

A STEEL CANTILEVER BRIDGE is being built over the Spokane River at Spokane, Wash., by the Smith Bridge Co., of Toledo, O. The bridge has a total height of 1,135 ft., and consists of 3 cantilever spans, one 277 ft. 4 ins., two 189 ft.; 3 steel truss spans, 105 ft., 90 ft. and 54 ft. long, respectively, and trestle approaches. The distance between centers of trusses is 30 ft., the roadway is 38 ft. 8 ins. and there is an 8 ft. 8 ins. sidewalk at each side. The roadway will carry double tracks for a street railway, and will be laid with 2-in. pine plank spiked to 4 × 16 in. floorbeams, bolted together in pairs, except underneath the street-railway rails, where single 7 × 16 in. beams will be used. The bridge will be supported on iron trestlework piers.

THE BRUSH STORAGE-BATTERY PATENTS are sustained by Judge COXE, of the U. S. Supreme Court. This decision substantially ends the triangular litigation which for five years has been going on between the Julien Electric Co., the Brush Electric Co. and the Electrical Accumulator Co. This decision has been rendered in the case of the Consolidated Electric Storage Co., successors to the Julien Co., and the purchasers of the exclusive right to use the Brush storage battery in the United States against the Electrical Accumulator Co. An immediate result of the action of Judge COXE will be the replacing of the storage-battery cars on the Fourth Avenue street railway. So says Superintendent SKIFT of that line.

THE WORST ACCIDENT OF THE WEEK in this country occurred July 25 at Middleton, O. An excursion train on the Cincinnati, Hamilton & Dayton R. R. stopped at that place to repair a broken drawbar and flagmen were sent out, it is claimed, in the proper manner. When the train finally drew out from the station about 250 persons were on the last three coaches, most of whom knew that freight train No. 44 was following. It is said that the conductor warned the passengers to jump from the car if they heard the freight. When the latter train was within sight of the station, its engineer saw the danger signals, called for brakes and turned on the sand. A minute later the collision took place. The excursion train was pulling out on the main track and all but the last two coaches had left the siding when the locomotive of the freight train struck the third coach and lifted it at an angle of 45°. The car caught fire, but the blaze was extinguished by the engineer of the freight train. The two following cars had been turned over into the ditch and 40 of the passengers more or less injured. Three persons were killed.

Another accident, nearly as serious and much more culpable, occurred July 24, on the Denver & Rio Grande R. R. a few miles from Carlisle, Colo. Eastbound narrow-gage train No. 6 disobeyed orders and ran into westbound standard-gage No. 3, runing on correct time. The two trains met on a sharp curve and while No. 3 was immediately brought to a stop the airbrakes on No. 6 were out of order, so that the train, running at 45 miles an hour, could not be appreciably stopped by the hand brakes. Four men were killed outright, three seriously wounded and several received severe injuries.

Locomotive explosions are reported at Plattsmouth, Neb., and Stamford, Conn., the first killing two men and injuring several others, and the second seriously injuring the engineer and fireman.

BRIDGE ACCIDENTS are reported as follows: Westbound freight train No. 83 broke in 3 sections just east of Waterboro, N. Y., on the N. Y., P. & O. R. R. July 23, at 8.30 P. M. Two of the sections came together on the center of the east span of bridge No. 6 with such force as to derail the cars and throw them into the main trusses of the bridge, thereby breaking the struts and destroying the structure. Nobody was injured. Three bridges are reported washed out at erokee, Ia., by a severe rain and wind storm.

THE ST. MANDE RAILWAY ACCIDENT, near Paris, as far as now known, has cost the lives of 50 passengers and has injured 104 others. Three cars were crushed by a rear explosion, and the wreck was then fired by the collision of a gas tank in one of these cars. The colliding trains were loaded with excursionists, and the true cause of the accident is not yet ascertained, though the station-master at Vincennes blames the driver of the second engine. Other officials claim that the signals were set wrong. The engine of the second train mounted on top of the rear carriage and telescoped the other two carriages. Forty minutes elapsed before water could be secured to put out the fire, but the firemen then used it so copiously that some of the wounded passengers are said to have been drowned.

A 140,000-MILE RUN WITHOUT ANY REPAIRS is the published record of locomotive No. 13,993 on the Pennsylvania Ry. This engine runs between Altoona and Pittsburg, and makes 408 miles per day.

THE DISPOSAL OF A PART OF THE SEWAGE OF PAWTUCKET, R. I., is the subject of a recent report by Messrs. S. M. GRAY and C. A. ALLEN, who advise the adoption of intermittent filtration for a period of 8 to 10 years, until connection can be made with the trunk sewer to be built by the city of Providence. The lands proposed as temporary filter fields contain 6¼ acres. Seven test pits, dug to a depth of about 6 ft., in different parts of this area show the material to consist of from 10 to 12 ins. of black loam and the remainder of variable quantities of fine sand, coarse sand, coarse and fine gravel, with a layer of very fine and compact sand underlying the coarser materials. While this formation is not of the best, it is believed that good beds can be produced with proper care. The report recommends bringing the surface to a level, taking pains to so grade the ground that the layer of fine compact sand shall always be about 5 ft. below the surface. Underdrainage is not recommended until later, and the cost of such work is estimated at $300 per acre. Soiling the land will probably add at least $250 per acre, but it is not advised unless irrigation is to be practiced when the flow of sewage is small.

THE PARIS MUNICIPAL COUNCIL has voted in favor of underground railways as preferable to elevated or viaduct structures as a means of rapid transit.

AUTOMATIC BRAKES ARE DEMANDED by the Southern Pacific and the Rio Grande Western railways in the following circular issued by these roads:

> On account of the large number of freight cars coming to us not equipped with automatic brake, our expenses have been largely increased, and the additional risk that we assume in allowing these cars in our trains has been the cause of many serious accidents.
>
> It has been decided that on and after Aug. 1 we cannot receive on our line at any of our connections freight cars not equipped with the automatic brake. Cars that we have heretofore taken into our trains piped, so as to work the air through them to the cars equipped with the automatic brake will hereafter be rejected.

THE LEARY TIMBER RAFT that lately reached New York in tow from St. John, N. B., according to fuller detail, was made up as follows: There were 16 sections or cribs, averaging 55 ft. in length, 40 ft. in width and 19 ft. deep. There were in the whole raft about 10,000 sticks of spruce and pine lumber, from 45 to 70 ft. in length, and running from 12 to 36 ins. in diameter at the butts. Including beech, birch and maple timber, there were about 3,500,000 ft. B. M. in the raft. The estimated cost of the raft to the owner was $40,000, the contract price for towing was $4,000, and the estimated value of the timber in New York is $80,000. This further detail also points out the danger of this raft-towing, as mentioned by us before. In a storm on June 28 13 sections broke loose and were tossed about like corks; but after a delay of two days—during which serious damage might have occurred to vessels crossing its path—the sections were recovered. There were no lights on the tripods erected on the cribs for this purpose during this period. The next few days after brought fog and further trouble. This tow of 1,100 ft. in total length traveled with an average speed of 1 mile per hour against wind and tide, and 3½ to 4 miles per hour with fair winds and tide.

The Moenchenstein Bridge Disaster.

We are at last able to lay before our readers something like the complete facts in regard to this terrible bridge disaster, by which, according to the latest and most probable records, 74 persons lost their lives and nearly 200 were more or less seriously injured, out of a total of possibly 500 passengers on the unusually heavy train. The following record contains some lamentable gaps, but is believed to be accurate so far as it goes, having been made on the spot as the result of personal examination.

The accident occurred on Sunday, June 14, 1891, at a small single-track bridge of 41 metres clear span (42 m. c. to c. of end plates) over the Birs River,

Fig. 1.—Map Showing Scene of Accident.

a small tributary of the Rhine, which bridge was about 2¾ miles out from the city of Basel, the great railway center of North Switzerland, and about ¼ mile short of the first station out from Basel (5 kilos or 3 miles therefrom), the insignificant village of Mönchenstein, which has now attained such unenviable notoriety. The position of the bridge may be seen from Fig. 1, a map of the country immediately south and east of Basel.

This station is on, perhaps, the principal line of the Jura-Simplon Railway, a private corporation operating the second or third largest railway system in Switzerland, aggregating nearly 1,100 kilometers, or some 680 miles in all. It is quite an intricate network of short lines, and is the principal passenger route between Paris and Switzerland, since it avoided all encroachment on or passage through the German frontier. Since the accident this business has become impossible, of course, and the traffic has been going by an entirely different route (via Mulhouse) to Paris, across German territory, the German government having relaxed *pro tem.* its passport regulations. This traffic is, of course, quite a serious loss to the Jura-Simplon company, which makes the more curious the facts reported below as to the delay in reopening the line to traffic. The Jura-Simplon line is the one for which and under whose auspices the great Simplon tunnel is projected.

The wrecked train was the regular one for Neufchatel, but much heavier than usual, because of a local fête at Mönchenstein, to which a great crowd was attracted from Basel. It consisted of no less than 12 different vehicles (8 4-axle and 4 2-axle) weighing in all 150 *tonnes* (of 2,204 lbs.) and having seats for 572 passengers, which were nearly all occupied, there being perhaps 500 passengers on the train. Though the total weight of the train was hardly more than that of an American train of six cars (with say 2 sleepers and 4 coaches), which would be considered an easy load for one engine over fairly good grades, after the liberal European fashion it was provided with two very heavy engines, weighing with loaded tender 60 to 66 *tonnes* (66 to 73 tons) each, and having 18 × 26 in. cylinders. At least the head one did; the second one was a compound of otherwise similar class, with 18 and 26 × 26 in. cylinders. Fig. 2 shows the wheel-loads in detail with approximate correctness, as furnished to us on the ground by the mechanical superintendent of the line. The following table gives details of the train, similarly obtained:

	Axles.	Seats.	Length, metres.	Wt., *tonnes* of 2,204 lbs.
1. Baggage car	2		10	9
2. Third-class car	4	70	15	14
3. " "	4	70	15	14
4. Postal "	2	..	10	9
5. Express "	2	..	10	9
6. Second-class car	4	56	15	15
7. Third " "	4	70	15	14
Total cars destroyed.	22	206	90	84
8. First, second and third-class cars hanging on abutment	4	56	15	15
9. Third-class car	4	70	15	14
10. " "	4	70	15	14
11. " "	2	40	10	9
12. " "	4	70	15	14
Total cars not destroyed	18	306	70	66
Total of train	40	572	160	150
Passengers therein at 50 kilos. per seat				28.6
Weight of the two engines				126
Total weight of train				304.6 Tons.
Total wt. each engine on drivers				36
" " " " truck				9
" " " " tender				9
" " " " *full* load				12
Total				66

The actual weight was estimated at 63 tons each.

Total span of bridge c. to c. end-plates	42.00 m.
" length two engines	27.90 "
Excess occupied by cars	14.10 m.

The bridge was one built by Mr. EIFFEL in or about 1874-6, or 16 or more years ago. The great fame which Mr. EIFFEL has since attained as a bridge designer would seem to forbid the suspicion that he could have made any serious errors in designing so simple a structure as this even 16 years ago, and we are informed that since the accident he has made a public statement denying that he was in any way responsible for the design of the structure, he having merely built it as contractor from designs of Swiss government engineers. From a statement in the *Centralblatt der Bauverwaltung* it appears, however, that the directors of the railway company furnished simply sketches and load diagrams, the contractors furnishing the completed designs.

When the bridge was erected the Jura, Bern & Luzern Ry., as it was then called, depended principally upon local traffic. When the severe passport regulations of the German empire went into effect between Alsace and France, the greater part of the through traffic was diverted from the old line by way of Mulhouse to the route via Delle, Delsberg and Basel. The weight of the trains and locomotives increased to such an extent that PROBST, WOLF & CHAPPUIS were finally engaged to investigate the strength of this bridge as well as that of other structures on the same line. It was found that the trusses were perfectly able to carry the loads then customary, the bridge having been designed with the very low permissible strain of 6 kilos per sq. mm. or 8,534 lbs. per sq. in., as is still customary in France. The floor system, however, was found to be deficient in strength and the following changes were made:

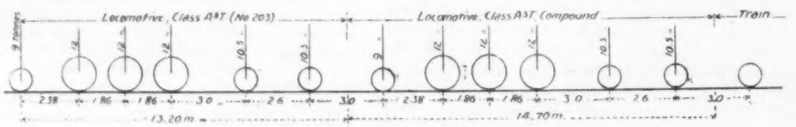


FIG. 2.—DIAGRAM OF TRAIN LOADS.

1. The connection between the floor beams and stringers were strengthened by adding a second angle.

2. The floor beams were strengthened by diagonal stiffeners, running from the lower outer corners of the beams to the top of the vertical stiffeners.

3. An additional cover plate was added to the top flange of the floor beams.

4. The floor beams and verticals were connected by triangular brackets.

These changes were made last year and are fully shown in Fig. 3. Previously, however, in 1881, a freshet had partly destroyed the left abutment, so that the bridge was twisted out of position, one point of support sinking 75 cm. (29½ ins.) and another rising free from the abutment. The bridge was strained to such an extent that a number of diagonals and floor beams were badly damaged. According to the *Schweizerische Bauzeitung* all these members were not removed, but merely reinforced with cover plates riveted over them. If this statement should prove to be correct, as the high-standing of the *Bauzeitung* leads us to believe, the bridge was certainly in bad condition. Many of the members had been so severely strained that they were undoubtedly weakened to some extent and those parts that were patched up and then allowed to remain could not have been as strong as members containing an equal amount of sound metal properly distributed.

The so-called reconstruction of the foundations in 1881 was wholly unimportant as regards the present disaster. The masonry abutments were in perfect condition, and as solid as natural rock to all appearance.

Fig. 4, from the plans published in the Swiss technical papers, shows the bridge as it was before the accident. It was 42 m. (137.76 ft. long, c. to c. of end plates, and divided into 6 panels of 7 m. each, which in turn were cut by suspension angle bars into 12 half-panels, at each of which there were heavy cross-girders, with which we need not concern ourselves much, as the cause of the disaster hardly lay in them. That they were much stronger than their supports will appear tolerably clear from following details. The truss was 6 m. high out to out and about 4.6 m. wide between centers of chords.

Before entering into further details we will see what the wreck itself has to tell of the disaster. Fig. 5 gives a general view of the front part of the wreck from the up-stream side; Fig. 6, of the rear part of the wreck from the down-stream side. Fig. 7 shows some of the details of the structure pretty well, looking backward from the down-stream side. All these views are from photographs taken before the wreck was seriously disturbed. From them and some other facts gathered on the ground we can predicate the following facts at least.

1. *The failure was of the bridge, not of the abutments.* The latter were perfect and of the most permanent character.

2. *There was no derailment.* This is proved in the most positive manner by the condition of the track approaching the bridge, the testimony of the enginemen, and the condition of the ties removed from the wreck. Of the last some two dozen were preserved. One or two only had distinct marks of flanges passing over them, and these did not match each other. All the rest were wholly free from such marks, as was the track on the approach. The enginemen testify that they felt no shock until the bridge began to give way under them. The first engine had advanced pretty well onto the abutment, but was pulled backward perhaps half its length into the abyss, as may be inferred from Fig. 5, where the second engine extends from about the middle of the bridge to the first panel point on the left (down-stream) side, which was a half-panel shorter than the opposite side, owing to the skew of the bridge, 60°. [The commissioners appointed to investigate the accident, Profs. RITTER and TETMAJER, are reported to lean toward a derailment as the cause.—ED. ENG. NEWS.]

3. *The speed was very low*, probably about 15 miles per hour at most. This may be inferred in the first place from the fact that the schedule speed was low. The train was unusually heavy (for Europe), requiring careful handling. In fact, it must be difficult to handle safely even so heavy a train as this with the light coupling gear in use, which has not more than one-fifth or one-sixth of the resisting strength of American passenger coupling gear, as we shall show more fully later. To this comparative flimsiness of construction, as we shall shortly see, the frightful slaughter in this accident is to be directly and wholly attributed. Had it been an American train running over the bridge any heavy loss of life would have been practically impossible.

Moreover, the train was just approaching a station at which it was to drop most of its passengers, and had been running only 3 miles in all, up grade. As it is not usual in any country to attempt to make up time under such circumstances on such a short stretch, we might be tolerably sure under any circumstances that the speed was low, but the testimony of the wreck itself is decisive on that point.

It will be seen from Fig. 5 that the two engines occupied in peace and quietude, so to speak, the latter half of the broken span. They did not mash each other up; neither was the rear tender mashed up by the cars. Let us assume a speed of 15 miles per hour (22 ft. per second) and a dead fall of 12 to 14 ft. They would fall this distance in about ¾ second, during which they would advance about 17½ ft. Moving them 17½ ft. back from the position in which they stood at the instant of fracture, would bring the drivers of the leading engine on the last panel point of the up-stream side, and nearly on the solid on the down-stream side.

Coming now to the cars, Figs. 6 and 7, it will be seen that behind the rear engine, and quite clear from it, there was a confused heap of wreckage, perhaps 40 ft. in diameter, in which, as will be seen from the preceding table of the train, not less than 7 cars, 4 of them passenger cars, were piled together. In these cars there may have been 250 passengers. Their total weight, however, was only 84 *tonnes*, or about that of 4 of our passenger cars, and the number of axles was 22, or enough for, say, 5 of our cars.

It is difficult to imagine how these cars could have piled themselves one above the other in the small space they did, but the difficulty partly vanishes when we remember the shortness and (above all) frail construction of the cars, and especially of the couplings. In any case of this kind, where there is serious and quick disturbance of the "axiality" of the train, so to speak, the couplings of all European rolling stock compare better with clay-pipe stems than with American coupling gear. Each coach becomes at once a disconnected, independent vehicle as it reaches the brink, and Fig. 6 reveals plainly that the general tendency of every one was to jump about 20 ft. in falling 15 ft., each successive vehicle pushing the prior wreckage forward more or less. From this it is an easy deduction that the horizontal speed could hardly have been much above 20 to 22 ft. per second, or, say, 14 to 15 miles per hour. Had the speed been much above this some of the rear cars would all but certainly have run out over the rear locomotive.

Even this would not explain how so many cars could have been crushed into so small a space, except for the further fact that the top works of European passenger cars are specially light and frail, incapable of standing any considerable crushing blow. They are perhaps a little stouter than the upper works of our street cars, but not much. The strength (what there is of it) all lies in the lower frame. Thus, as each car in succession struck the top works of the one before it, the latter collapsed into kindling-wood, and the only part which occupied much space was the running gear and lower frame.

Having determined the preceding points with a pretty high degree of certainty, we now come to the following, which are almost equally certain:

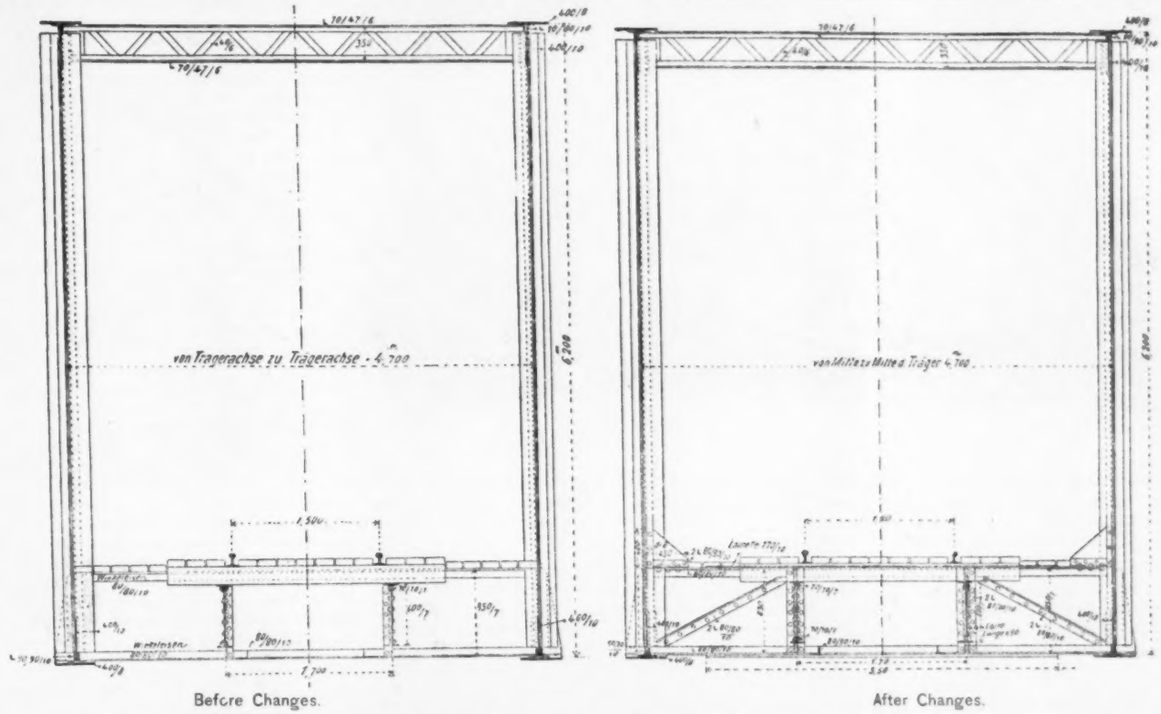


FIG. 3. CROSS SECTION OF BRIDGE SHOWING CHANGES MADE IN THE FLOOR SYSTEM. Dimensions in Millimeters.

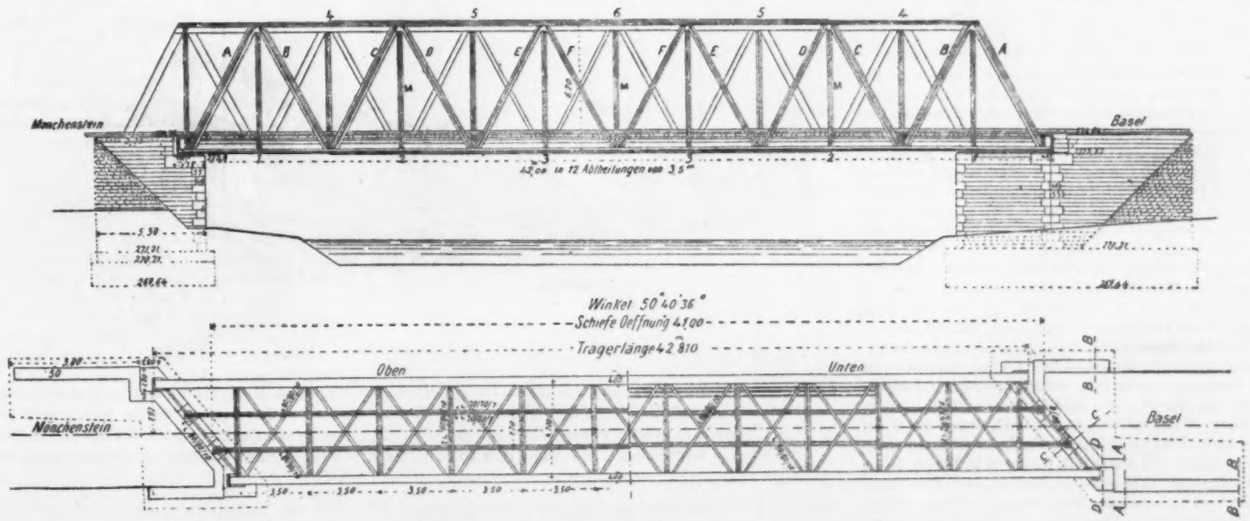


FIG. 4. PLAN AND ELEVATION OF BRIDGE. Dimensions in Meters.

4. *The first break was on the right or up-stream side of the bridge.* The cant of the other end of the bridge to the down-stream side (Figs. 5, 6), the position of the leading locomotive (Fig. 5) and the general position of the fallen bridge show this clearly, in connection with the following:

5. *The first break was in the last panel, but not in the chord*, because this was the only panel which was sustaining a maximum load at the instant of fracture; all the rest had been sustaining a heavier load a few instants before than at the time of the fracture. It is to be remembered that in failures of this kind the failure is practically instantaneous. There is no warning nor gradual yielding; that has been going on before undetected. A wooden bridge may fail somewhat more slowly, but in any truss, a failure in any member means that gravity at once acts freely on the whole mass. Therefore there can have been no beginning of actual rupture until perhaps a second before the truss and load struck the bottom. It is true the chords were sustaining about their maximum strain at the instant of failure, but had the first rupture been in the chords it would have been somewhere near the central panels of the structure, where the chord (so far as could be determined from the wreckage, without drawings) was much weaker in proportion to the strains than at the extreme ends, where the first failure certainly occurred. [An approximate calculation of the stresses at the moment of failure is stated by Herr MANTEL, a well-known Swiss engineer, to show a strain of 950 kilos per sq. cm. in the under chord, 715 in the upper chord, and 845 kilos in the end post. These figures correspond to 13,500, 10,100 and 12,000 lbs. per sq. in. In the *Centralblatt der Bauverwaltung* appeared a calculation of the bridge which would indicate that the faulty design of the panel-points produced bending and torsional strains under heavy loads that were excessive, amounting to over 49,000 lbs. per sq. in.—ED. ENG. NEWS.]

Fig. 5. View Looking Down Stream the Morning After the Accident, Taken Before Any Serious Disturbance of the Wreck. Break Apparently Occurrred in the Panel Where a Chord Enters the Water in Frunt of the Overturned Locomotive.

The parts where the first failure may have occurred, therefore, are reduced to (1) the end post or the one next to it, (2) the end tie, (3) the end floor beam, which by failure might have caused the collapse of the truss. The latter, which was very badly broken, and from its appearance after rescue from the wreck (as shown in a detail photograph, which we do not reproduce) would seem to be indicated as the cause of the failure, can hardly have been so, since its bad fracture is sufficiently explained by the way in which the beam fell, outlined in Fig. 8, from a photograph. It is possible, indeed, that this beam might first by breaking have caused the accident, and then by chance have fallen so that it must have broken as an effect if not as a cause. But the chance is too remote for consideration that a fracture amply explained as an effect could likewise have been the cause.

The indications of the wreck alone, therefore, as photographed after the event, locate the first failure in one of the end posts or ties at the farther end of the up-stream or right truss. It now becomes of interest to see what was the character of these members.

The posts were determined, by first inspection, to be of as poor design, perhaps, as ever went into a bridge. The sections of the members are shown in Fig. 9, and any one who desires can, by computing the strain on them, from a strain sheet of the structure, and their probable safe load, see whether or not our conclusion is correct that one of the posts was overstrained and gave way. It will be seen from Fig. 9, that the compression members consisted simply of a flat plate of metal to which "fins" of half its width were attached by *two* angle irons only, so as to make an equal sided cross. The plates were all quite thin in proportion to their width; the angles were at the axis of the figure, where they added no stiffness; the poor precaution of adding an angle in each corner so as to make the section symmetrical at least was neglected, and the pitch of the rivets (20½ cm.) was so considerable that, after the accident at least, daylight could be seen right through the butting "joints" for about half the length of every post.

It has been our melancholy duty to chronicle the facts in regard to a great many poor bridge details from time to time; but taken for all in all, we do not remember to have seen any details before of any structure which so palpably invited disaster as did the details of this structure. The chords, be it remembered (see Fig. 6) were as loose-jointed as the posts. Their general construction is shown in Figs. 9 and 10, the pieces, *a*, being after-thoughts (if we were correctly informed) added during the recent "strengthening." Ordinarily, one expects to find the chord made strongest in the center of the truss, but, for some unexplained reason, the outer pair of these added strips ran out from the abutment past the first panel point only, *and there stopped.* At least this seemed clear and unmistakable from the parts of the wreck which were open to examination 10 days after the accident (which were nearly all the parts), though we trust there was some mistake in our observations in regard to this, which were not particularly careful in respect to the chords, since it was clear that the point of first failure did not lie in them.

More exactly than we have located it the point of failure probably never will be located, but it is especially important to do so. It is found to lie certainly with two or three members each of which was defective enough in design to readily admit of failure. The joining of the posts with the chord should also be studied in this connection. As may be inferred from the Fig. 11 one arm of the angle was sheared off where it came in the way of making the joint, instead of shearing off one edge of the side plate and spreading the angle out to give room for the vertical plate of the chord to enter.

The exact responsibility for the accident will probably be long a subject of dispute. M. EIFFEL has tried to evade responsibility for it by declaring that he was merely carrying out the plans of the company's (not government) engineers, as before noted, but it is indignantly denied that they had any responsibility. One thing is certain: the plans all bore M. EIFFEL'S signature, and that ought to carry with it full responsibility for the safety, if not for the economy, of the structure. It is possible that between the two stools safety fell to the ground. The company's engineers made just enough of a general plan to relieve M. EIFFEL of a due feeling of responsibility in working up details, while they in turn had trusted to him to make the details all right. Be this as it may, the engineer who signs the plans and is the ostensible engineer of the structure will justly be held to a strict responsibility for the consequences of defects, whether or not a portion of the blame also falls on others. It hardly seems probable that any European engineer of established reputation would now father such a structure, as certainly no American one would, but the bridge was built a long time ago in the history of bridge engineering, and there is as yet no known reason for suspecting that any engineer felt disposed to feel anything but pride in the part he had had in devising the structure until it failed. If there be an iron railway truss in any part of America which in inherent and evident badness of design was fairly comparable with this structure we do not know of it, nor know of any reason to suspect it. The floor-beam hangers of the Bussey Bridge (ENGINEERING

Fig. 6. View of Wreck Looking Upstream. Taken Before Any Disturbance of Pieces Other Than the Removal of Parts Immediately Under the Left Abutment and Wooden Portions of Cars to Facilitate the Search for Bodies. The Canal-like Appearance of the River is Due to the Straightening and Controlling of the River Bed so Often Practiced in Switzerland. The Water Was 3 to 5 ft. Deep and the Bottom Apparently Hard Sand and Gravel.

NEWS, March 19, 1887) came to our mind as the nearest parallel, but their probable weakness was not so instantly evident to the eye, and did not obtrude itself throughout the structure, besides which the Bussey Bridge was not designed by an engineer of

Fig. 7. View Looking Backward From Upstream Side, Showing Some Details of Construction

world-wide reputation, nor of any reputation, but by a man who did not even pretend to be an engineer at all.

An interesting and curious feature of this disaster which is hard to describe, and yet is perhaps at least equally significant, was the way in which the wreck was cleared away, or rather *not* cleared away. It will seem to American railroad men almost impossible that the following facts should be true of an accident on one of the important railway systems of Europe; yet they are all strictly true and gathered on the spot.

Fig. 8. View Showing End Floor Beam on the Left. The Manner in which it Fell Would Cause any Breaks it May have.

The accident occurred Sunday, June 14, at 2:30, P. M., within three miles of the principal railway yard of Switzerland. The river was not specially high nor rapid. A man could wade across and stand in the current. The bottom was hard sand and gravel. Large supplies of timber and iron were within easy reach by rail or wagon; 50 to 200 dead bodies were supposed to lie in the wreck; much of the traffic of the line was being diverted to another and a foreign line; there was every reason and every opportunity for quick work in reopening the line.

Under these circumstances, by Monday morning, some 17 hours after the disaster, 46 of the more accessible dead bodies had been removed. The rest, with all the heavy wreckage, were in place.

On Monday, June 15, a few more bodies were taken out and some of the light wreckage was cleared away.

On Tuesday, June 16, most of the bodies were taken out and more of the light wreckage was cleared away. The railway company resigned control of the work to the authorities of Baselland (the Swiss canton in which the accident occurred).

On Wednesday, June 17, transferring of traffic past the wreck stopped and it was all sent around through Germany, via Mulhouse. Parts of the broken bridge (those above water) began to be cut off and removed, with the upper wreckage.

On Thursday, June 18, control of the wreck passed by petition of the city of Basel into the hands of the federal authorities, the engineer in chief of the railway department taking charge. A battalion of engineers was ordered to the spot, with a very pretty park of wagons for field telegraphy and general engineering work, and some spotless black pontoons, which were soon launched in the river and tied up against the bank.

On Friday, June 19, desultory clearing of wreck continued slowly, and it was determined to build *a wooden truss bridge* of about the same span as the ruined structure (say 120 ft.) to carry a temporary track around the wreck. Material for this was ordered. Permanent shanties for tools, officers' headquarters, etc., began to be built.

On Saturday, June 20, the first derricks or cranes of sufficient strength to handle heavy pieces of wreckage effectively arrived on the ground. Even they were not equal to more than about 5 tons each (there were three or four of them), and they did little work for the next two days. The leading locomotive was finally all removed, piece by piece.

On Monday, June 22, it was pretty well determined that no more bodies remained in the wreck to be removed, and work as above outlined slowly continued.

On Tuesday afternoon, June 23, as shown by a personal examination made for this journal, the state of the work was as follows, this being *nine days* after the accident occurred:

The rear engine and tender complete and the tender of the leading engine still lay in the stream precisely as and where they had originally fallen (a few light, unimportant parts excepted). The parts of the truss which appear above water in the views had been laboriously cut off at the water's edge, removed in small pieces, and piled along the bank. The car wreckage had been pretty well cleared away and piled up on the bank; little of it showed above water. Work was not being done at night nor during noon hours. Two or three groups of soldiers were from time to time pulling directly, *without block and tackle*, at submerged bits of wreckage to which two or three more men who were wading about in the steam from time to time fastened ropes. Two or three other men were endeavoring to get a sling around the rear locomotive, to what purpose was not clear, as the cranes at hand (which were idle) seemed unequal to the task of lifting even the boiler alone.

Good temporary footbridges had been erected across the stream and all about the wreckage, which were highly convenient for purposes of inspection. About 40 or 50 men were standing about ready to help when desired. A good permanent camp had been established as noted; the officers in charge were housed in about such a building as would ordinarily be erected for a resident engineer's office in America. The lower chords of the temporary span had been nearly completed, the south approach to it had been piled out to the edge of the stream. Piles for the north approach to it were being sharpened and shod with iron on the other side. In general, the state of the work and the way in which it was being conducted indicated that it would be at least two weeks more, or 23 days after the accident, before it was likely that a locomotive would cross the river and traffic be resumed. As a matter of

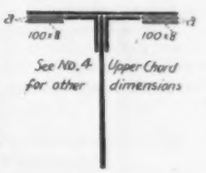


Fig. 10. Section of Top Chord, First Panel, as Found by Personal Examination of Wreck.

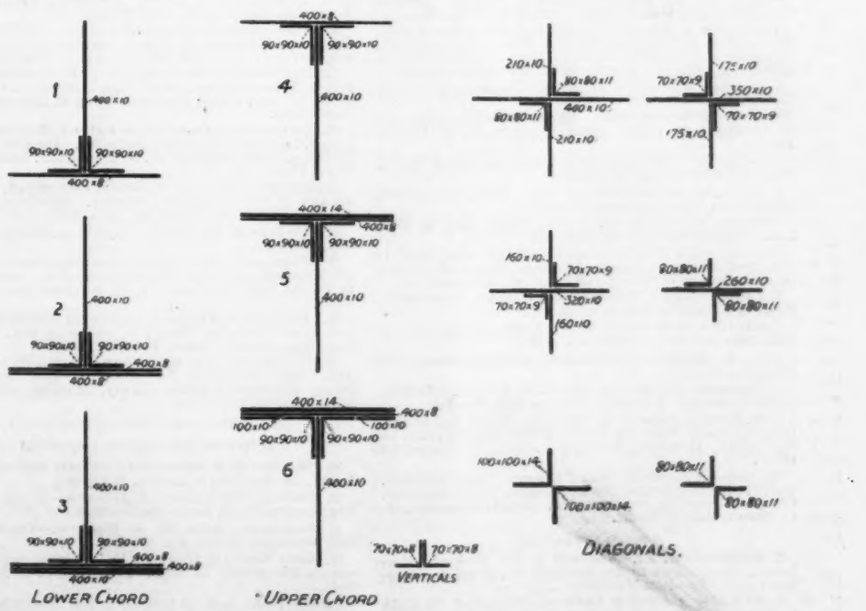


Fig. 9. Sections of Members; From Schweizerische Bauzeitung, as Corrected by Herr Dumur, Director of the J. S. B. Ry. Co.

'act we learn by inquiry of GEO. GIFFORD, Esq., U. S. Consul at Basel, that it was late in June before the wreckage was completely removed from the river, and not until July that a locomotive passed over the temporary track and traffic was resumed. The line and bridge, as we have noted above, are single-track.

We have set down these circumstances thus particularly, not to reflect in any way upon the officers in charge, whose courtesy and kindness in affording information and facilities we desire to cordially acknowledge, but because they seem to us to carry with them an important moral, which we noted elsewhere. We need hardly say that on any line in America of corresponding importance two or three days would have been considered ample time both to remove the wreck and to construct a temporary track around it, in such a locality, and under such favorable conditions, while in our military practice

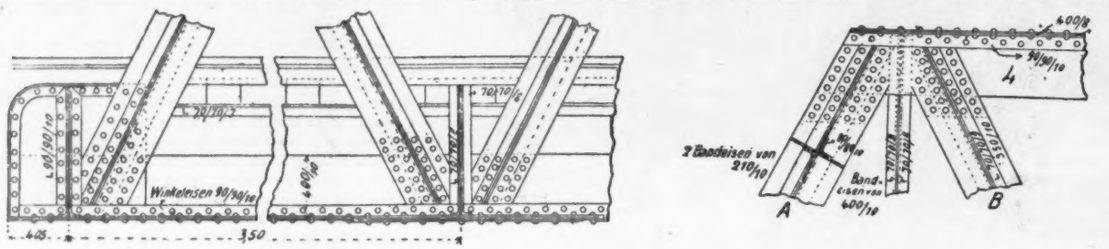


FIG. 11. DETAILS OF END CONNECTIONS OF UPPER AND LOWER CHORDS.

a few hours would have sufficed for the latter work. Had the circumstances been such as to indicate that there was any exceptional display of slowness or incapacity for such special work at this wreck it would have been both useless and invidious to detail the circumstances thus fully. We do not believe it. We have seen no reason to believe, and we do not believe, that there is a railway within 300 miles of the scene of this disaster (which is a long way in Europe) where practically greater efficiency of the "two-o'clock-in-the-morning" kind would have been known. Therefore the facts have seemed worth detailing fully.

Statistics Showing the Progress and Prospects of Railway Construction in the Northwestern States.

[WITH MAP NO. 37.]

ILLINOIS.—Existing Roads.

Belleville & St. Louis.—Under contract, East St. Louis to Belleville, 13.5 miles. President, Wm. A. Adams, Chief Engineer, Wm. A. Ries; both of St. Louis, Mo.

Centralia & Chester.—Track laid since Jan. 1, 1891, Coulterville to Oakdale, 8 miles. Under construction, Oakdale to Nashville, 7 miles. Surveyed, Nashville to Altamount, 96 miles; Sparta to Ste. Genevevc, 20 miles.

1. ***Chicago & Eastern Illinois.***—Under construction, Tuscola to Shelbyville, 41 miles.

Chicago & New Orleans.—Under contract, Altamont to Paducah, 130 miles. Chief Engineer, C. P. Moore, Farina.

Chicago & Southwestern.—Track laid since Jan. 1, 1891, in city of Chicago, 4 miles.

2. ***Chicago, Milwaukee & St. Paul.***—Projected, Shullsburg, Wis., to Galena, 20 miles.

Chicago, Peoria & St. Louis.—Track laid in 1890, Litchfield to East St. Louis, 48 miles.

Elgin, Joliet & Eastern.—Track laid since Jan. 1, 1891, East Aurora to Aurora, 1.1 miles. Surveyed, branch to proposed new stockyards in Lake Co., Ind., 10 miles.

3. ***Indianapolis, Decatur & Western.***—Surveyed, Decatur to Beardstown, 81 miles.

Louisville, Evansville & St. Louis.—Track laid in 1890, Belleville to Centralia, 48.7 miles.

Ohio & Mississippi.—Located, Cypress Junction to Paducah, 54 miles.

4. ***Pawnee.***—Under contract, St. L. & C. Junction to Auburn, 5 miles. Projected, Pawnee east, 20 miles.

5. ***St. Louis, Alton & Springfield.***—Track laid in 1890, Lock Haven to Elsa, 6.3 miles. Partly graded, Bates to Springfield, 14 miles. Surveyed, Alton to Venice, 20 miles.

St. Louis, Chester & Grand Tower.—Under contract, East St. Louis to Grand Tower, 65 miles. Chief Engineer, Clifton F. Stephens, St. Louis, Mo. General Manager, M. C. Brown, East St. Louis.

Projects and Surveys.

6. ***Beardstown, Ft. Madison & Des Moines.***—Projected, Beardstown to Ft. Madison, Ia., 60 miles. President, C. V. Chandler, Macomb.

7. ***De Kalb, Aurora & Eastern.***—Projected, De Kalb to Aurora, 25 miles. A. W. Fish, De Kalb.

8. ***Joliet, Lisbon & Western.***—Projected, Joliet to Illinois River, 40 miles. James Johnson, Lisbon.

Marion & Duquoin.—Surveyed, Marion to Duquoin, 37 miles. D. R. Harrison, Herren Prairie.

9. ***Muscatine, Rock Island & Peoria.***—Projected, Muscatine to Peoria, 90 miles. Andrew Perry, Peoria.

10. ***Pana & Roodhouse.***—Projected, Pana to Roodhouse, 70 miles.

11. ***Quincy, Keokuk & Chicago.***—Projected, Quincy to Niota, 50 miles. Chief Engineer, F. C. Horn, Exchange Building, Chicago.

12. ***St. Louis & Northern.***—Projected, Rock Island to Havana, 90 miles. Marcus Hook, Jacksonville.

Total.—Track laid in 1890, 103 miles. Track laid since Jan. 1, 1891, 13.1 miles. In process of construction, 276 miles. Surveyed or under survey, 318 miles. Projects of some promise, 455 miles.

WISCONSIN.—Existing Roads.

2. ***Chicago, Milwaukee & St. Paul.***—Track laid in 1890, Necedah to Babcock, 18.9 miles; Lynn, northwest, 2.16 miles. Surveyed, north of Lynn to Thorpe, 30 miles.

13. ***Chicago, St. Paul, Minneapolis & Omaha.***—Sault Ste. Marie & Southwestern R. R.—Track laid in 1890, Elva to Mondovi, 9 miles. Projected, Mondovi to Alma, 20 miles.

14. ***Escanaba, Iron Mt. & Western.***—Partly graded. Iron Mt., Mich., to Florence, Wis., 15 miles.

15. ***Goodyear, Neillsville & Northern.***—Track laid in 1890, Goodyear to McKenna, 2 miles; branch lines, 5 miles. Track laid since Jan. 1, 1891, McKenna to Zeda, 1 mile. Surveyed, Goodyear to Neillsville, 20 miles. C. A. Goodyear, Tomah.

16. ***Illinois Central.***—Chicago, Madison & Portage R. R.—Projected, Madison to Portage, 40 miles.

17. ***Kewaunee, Green Bay & Western.***—Under construction, Kewaunee to Green Bay, 32.5 miles. President, W. J. Abrams; Chief Engineer, S. B. Fisher; both of Green Bay.

18. ***Kickapoo Valley & Northern.***—Partly graded, Wauzeka to Wilton, 80 miles. Vice-President, B. F. Washburn, Excelsior.

19. ***Milwaukee, Lake Shore & Western.***—Track laid since Jan. 1, 1891, Wausau to Big Eau Plene River, 27 miles. Under construction, Big Eau Plene River to Marshfield, 13.6 miles.

20. ***Milwaukee, Menominee Falls & Western.***—Track laid in 1890, Wisconsin Central R. R. to Sussex, 1.6 miles.

21. ***Port Edwards, Centralia & Northern.***—Track laid in 1890, Port Edwards toward Marshfield, 20 miles. Track laid since Jan. 1, 1891, end of track to Marshfield, 10 miles.

22. ***Wisconsin Central.***—Track laid in 1890, Marshfield toward Grcenwood, 5 miles. Track laid since Jan. 1, 1891, end of track to Greenwood, 17.5 miles.

Projects and Surveys.

23. ***Chicago, Baraboo & Northern.***—Projected, Jefferson to Kilborne, 60 miles. President, Frank Avery; Secretary, Chas. Junge; both of Buraboo.

24. ***Chicago, Lake Geneva & Pacific.***—Projected, Lake Geneva to Jefferson, 40 miles. President, W. A. F. Norris; Secretary, Chas. M. Morris; both of Madison.

25. ***Eau Claire, Mississippi & Lake Superior.***—Projected, Winona, Minn., to Cleveland, 200 miles. President, R. F. Wilson; Chief Engineer, Chas. E. Bussell; both of Eau Claire.

26. ***La Crosse, Black River Falls & Eastern.***—Projected, La Crosse to Antigo, 150 miles. President, Hugh H. Price; Chief Engineer, W. D. Henderson; both of Black River Falls.

Milwaukee Belt & Terminal.—Surveyed, in and around city of Milwaukee, 50 miles. President, Frederick W. Kalbfleisch, 36 New St., New York City.

27. ***Phillips & Kennon.***—Projected, Phillips to Kenton, 15 miles.

28. ***Wisconsin Bee Line & West Superior.***—Projected, Milwaukee to West Superior, 360 miles. President, C. D. Smith; Chief Engineer, C. W. Newton; both of Fond du Lac.

29. ***Wisconsin Midland.***—Surveyed, Madison to Michigan State line, with branch to Sturgeon Bay, 297 miles. Secretary, Dana C. Lamb, Fond du Lac.

Total.—Track laid in 1890, 637 miles. Track laid since Jan. 1, 1891, 55.5 miles. In process of construction, 276 miles. Surveyed or under survey, 318 miles. Projects of some promise, 1,055 miles.

MICHIGAN.—Existing Roads.

(Lines within limits of map only.)

30. ***Chicago & Northwestern.***—Track laid since Jan. 1, 1891, Crystal Falls to Amasa, 13.4 miles.

31. ***Duluth, South Shore & Atlantic.***—Under survey, Negaunee to North Escanaba, 55 miles.

14. ***Escanaba, Iron Mt. & Western.***—Track laid in 1890, Escanaba to Iron Mt., 53 miles.

32. ***Iron Range & Huron.***—Under construction, Arvon to Champion, 35 miles. President, C. H. Buhl, Detroit.

Total.—Track laid in 1890, 53 miles. Track laid since Jan. 1, 1891, 13.4 miles. In process of construction, 40 miles. Surveyed or under survey, 35 miles.

MINNESOTA.—Existing Roads.

33. ***Duluth & Iron Range.***—Projected, Ely to international line, 50 miles.

34. ***Duluth & Winnipeg.***—Track laid in 1890, Grand Rapids northwest, 11 miles. Under construction, Cloquet to Duluth, 15 miles. Surveyed, end of track north of Grand Rapids northwest, 50 miles. Projected, end of survey to international line, 100 miles.—Itasca Lumber Co. Under construction, Grand Rapids north, 25 miles.

35. ***Duluth, Red Wing & Southern.***—Projected. West Superior to Red Wing, 150 miles.

36. ***Duluth Transfer.***—Track laid in 1890, in West Duluth, 3.5 miles. Track laid since Jan. 1, 1891, in West Duluth, 2 miles. Surveyed, Duluth to Ironton, 7 miles.

37. ***Northern Pacific.***—Track laid in 1890, Crookston to Carthage, 22.1 miles.

38. ***Wadena & Park Rapids.***—Track laid since Jan. 1, 1891, Eagle Bend to 20 miles north of Wadena, 29 miles. Graded, end of track to Park Rapids, 16 miles. President, Wm. Crooks, Wadena.

39. ***Winona & Southwestern.***—Track laid in 1890, Utica to Spring Valley, 40 miles. Track laid since Jan. 1, 1891, Spring Valley to Iowa line, 15.6 miles; on Winona Bridge, 1.016 miles.

Projects and Surveys.

40. ***Duluth, Mesabi & Northern.***—Projected, Duluth to Mesabi Iron Range, 70 miles. President, K. D. Chase, Faribault; Secretary, S. R. Payne, Duluth.

41. ***Duluth, Red Lake Falls & Northern.***—Projected, Lake Superior to St. Thomas, N. Dak., 340 miles. President, C. H. Graves, Duluth.

Total.—Track laid in 1893, 32.6 miles. Track laid since Jan. 1, 1891, 57.6 miles. In process of construction, 56 miles. Surveyed or under survey, 57 miles. Projects of some promise, 535 miles.

NORTH DAKOTA.—Existing Roads.

42. ***Great Northern.***—Track laid in 1890, Grafton to Cavalier, 32 miles. Under construction, Halstead to Alton, 11.3 miles.

43. ***Minneapolis, St. Paul & Sault Ste. Marie.***—Under construction, Hankinson to Valley City, 80 miles. Partly graded, Aberdeen, S. Dak., to Bismark, 160 miles; Boynton to Aberdeen, Bismark line, 40 miles.

37. ***Northern Pacific.***—Track laid in 1890, Great Bend to Keystone, 6 miles.

Total.—Track laid in 1890, 38 miles. In process of construction, 241 miles. Surveyed or under survey, 20 miles. Projects of some promise, 2.) miles.

SOUTH DAKOTA.—Existing Roads.

44. ***Black Hills & Fort Pierre.***—Track laid in 1890, Navwatts to Piedmont, 14.6 miles.

45. ***Burlington & Missouri River.***—Track laid in 1890, Edgemont to Mystic, 74.8 miles. Track laid since Jan. 1, 1891, Mystic to Deadwood, 25.2 miles; Minnekahta to Hot Springs, 13.2 miles.

30. ***Chicago & Northwestern.***—Track laid in 1890, Whitewood to Deadwood, 9.12 miles. Buffalo Gap to Hot Springs, 14.12 miles. Projected, Pierre to the Black Hills, 160 miles.

2. ***Chicago, Milwaukee & St. Paul.***—Projected, Chamberlain to Black Hills, 200 miles.

46. ***Dakota, Wyoming & Missouri River.***—Under contract, Rapid City, west, 12 miles. Surveyed, 1-mile post to Hill City, 37 miles. President, Wm. S. Coad, Rapid City.

47. ***Deadwood Central.***—Traid laid since Jan. 1, 1891, Deadwood to Ruby Basin, 7 miles. Under construction, Gold Run to Baid Mt., 11 miles. Projected, Deadwood to Galena, 11 miles; Deadwood to Carbonate, 10 miles.

48. ***Duluth, Pierre & Black Hills.***—Under construction, Aberdeen to Faulkton, 42 miles; Faulkton southwest, 18 miles; Pierre northwest, 15 miles. Surveyed between Faulkton and Pierre, 48 miles; Oakes to Aberdeen, 54 miles. Chief Engineer, B. P. Tildon, Aberdeen.

49. ***Forest City & Gettysburg.***—Track laid in 1890, Forest City to Gettysburg, 16 miles.

Projects and Surveys.

50. ***Black Hills Central.***—Located, Rapid City to Wyoming line, 63.2 miles. President, J. Gregory Smith; Chief Engineer, Gilbert E. Bailey; both of Rapid City.

51. ***Huron, Chamberlain & Black Hills.***—Surveyed, Huron to Chamberlain, 79 miles. President, D. H. Henry, Chamberlain.

52. ***Midland Pacific.***—Surveyed, Sioux Falls to Pierre, 221 miles. President, Samuel L. Tate, Sioux Falls.

53. ***Rapid City, Missouri River & St. Paul.***—Surveyed, Rapid City to Cheyenne River, 40 miles. R. B. Hughes, Rapid City.

54. ***Sioux City, Madison & Northern.***—Surveyed, Garretson to Madison, 40 miles. President, Chas. B. Kennedy, Madison; Chief Engineer, E. D. Vincent, Sioux City, Ia.

Total.—Track laid in 1890, 128.7 miles. Track laid since Jan. 1, 1891, 57.4 miles. In process of construction, 148 miles. Surveyed or under survey, 562 miles. Projects of some promise, 28 miles.

NEBRASKA.—Existing Roads.

55. ***Chicago, Rock Island & Pacific.***—Track laid in 1890, South Omaha to Lincoln, 54.68 miles.

13. ***Chicago, St. Paul, Minneapolis & Omaha.***—Track laid in 1890, Randolph to Bloomfield, 21.8 miles. Surveyed, Bloomfield to Niobrara, 25 miles.

56. ***Kearney & Black Hills.***—Track laid in 1890, Kearney to Culloway, 66 miles.

57. ***Missouri Pacific.***—Track laid since Jan. 1, 1891 Union to Gilmore, 25 miles.

58. ***Pacific Short Line.***—Track laid in 1890, Sioux City Ia., to O'Neill, 128.5 miles.

59. ***Union Pacific.***—Track laid in 1890, Nantasket to Pleasanton, 3.02 miles.

Projects and Surveys.

60. ***Niobrara & Sioux Reservation.***—Surveyed, Verdigris to Niobrara, 12 miles. Chief Engineer, Sanford Horton, Niobrara.

61. ***Northwestern Improvement Co.***—Surveyed, South Sioux City to Homer, 15 miles. President, C. D. Smiley, South Sioux City.

62. ***Sioux City & Northwestern.***—Located, Sioux City, Ia., to Niobrara, Neb., 80 miles. Chief Engineer, L. F. Wakefield, Sioux City, Ia.

63. ***Yankton, Norfolk & Southwestern.***—Surveyed, Yankton, S. Dak., to Norfolk, 70 miles. President, Jas. H. Keller, Yankton.

Total.—Track laid in 1890, 274 miles. Track laid since Jan. 1, 1891, 25 miles. Surveyed or under survey, 202 miles.

IOWA.—Existing Roads.

64. ***Chicago, St. Paul & Kansas City.***—Surveyed, Des Moines to Omaha, Neb., 120 miles.

Sioux City & Northern.—Track laid in Sioux City, 1.28 miles.

39. ***Winona & Southwestern.***—Track laid since Jan. 1, 1891, Minnesota line to Osage, 21.7 miles. Projected, Osage to Mason City, 20 miles

Projects and Surveys.

65. ***Emmitsburg & Des Moines.***—Projected, Emmetsburg to Fonda, 40 miles. Geo. Fairburn, Des Moines.

Total.—Track laid in 1890, 1.28 miles. Track laid since Jan. 1, 1891, 21.7 miles. Surveyed or under survey, 120 miles. Projects of some promise, 60 miles.

MANITOBA.—Existing Roads.

Canadian Pacific.—Calgary & Edmonton Ry.—Track laid in 1890, Calgary to Red Deer River, 93 miles. Track laid since Jan. 1, 1891, Red Deer River to Pipestone Creek, 65 miles Under construction, Pipestone Creek to Edmonton, 31 miles. Surveyed, Calgary to Fort McLeod, 100 miles.—Southwestern Branch.—Track laid in 1890, Glenboro west, 21.3 miles. Under construction, end of track west, 5 7 miles.—Souris Branch.—Track laid in 1890, Souris to Hartney, 16.4 miles. Track laid since Jan. 1, 1891, Hartney to Melita, 27 miles. Under construction, end of track to Souris coalfields, 93 miles.—Qu Appelle, Long Lake & Saskatchewan Ry.—Track laid in 1890, end of track to Prince Albert, 138.4 miles.—Deloraine Branch.—Located, Deloraine to Melita, 25 miles.

Great Northwest Central.—Track laid in 1890, end of track north, 50 miles.

Manitoba & Northwestern.—Track laid in 1890, Saltcoats to Yorkton, 17.23 miles.

Northern Pacific & Manitoba.—Track laid in 1890, end of track to Brandon, 5 miles.

Port Arthur, Duluth & Western.—Track laid in 1890, Port Arthur to Fort William, 6 miles; Kenninistiquia River toward the international line, 23 miles. Track laid since Jan. 1, 1891, 43 mile post to 55-mile post, 12 miles. Under construction, 55-mile post to the international, 30 miles.

Projects and Surveys.

Atic-Okan Iron Range.—Surveyed, Canadian Pacific Ry. southeast, 55 miles. Chief Engineer, W. W. Russell, Port Arthur.

Manitoba & Southeastern.—Projected, Winnipeg to the international boundary, 100 miles. Chief Engineer, Alex. Stewart, Winnipeg.

Ontario & Rainy River.—Located, P. A., Dul. & Wis. Ry. to Atic-Okan River, 80 miles.

Total.—Track laid in 1890, 370.3 miles. Track laid since Jan. 1, 1891, 104 miles. In process of construction, 160 miles. Surveyed or under survey, 253 miles. Projects of some promise, 100 miles.

Late Armor Tests.

Deflective armor plates were tested at Indian-Head on July 24, the purpose being to test plates intended for the deck of armored cruiser No. 2, the *New York*. Plates were submitted by Cramp Sons and Carnegie, Phipps & Co., each firm sending two "constructive steel plates." The Cramp plates were 1¼ ins. thick, and had a tensile strength of 80,000 lbs. These two plates were placed one on top of the other, bolted together and inclined at an angle of 22°. A 6-in. gun, using a 100-lb. cast-iron shot, with 27½ lbs. of powder, was used. The striking velocity was 1,515 ft. per second.

Five shots were fired at each target, one shot in each corner and one in the center, as at the foreign armor plates at the September tests last year. The first shot struck the Cramp target 26 ins. from the top and 19 ins. from the right-hand edge. At the point of impact the plate was dished 3 ins. below the plane of its surface. The depression was elliptical-shaped, with its longest axis in the direction of the line of fire. The surface of the depression was smooth and coated with copper from the rotating band of the shell. There were no cracks. The second shot was 26 ins. from the top and 22 ins. from the left-hand edge of the target, and the results were similar to those of the previous shot. The third shot was directed at the center of the target, but owing to a slight error in sighting the gun, which was magnified by the angle of the target, the projectile struck between and on a line with the first and second points of impact. Both plates which composed the target were cracked through the center bolt hole at the top of the plate, but the crack could not be followed in the under plate. In the upper plate the crack curved to the rear of the first point of impact. The bolt was driven down through the bolt hole and the plate was dished 7 ins. deep there. This was, by accident, a severe test for the target, and the result would not have been disastrous to a vessel so protected in actual assault. The fourth shot was 21 ins. from the bottom and 19 ins. from the right-hand edge, with results similar to those of shots one and two. The fifth shot was 21 ins. from the bottom and 22 ins. from the left hand edge of the target, and was a duplicate of the preceding shot. The live-oak backing beneath the target was bruised, but not broken.

The test of the Carnegie plates was under the same conditions. The Carnegie plates were 1⅛ ins. thick each and were of nickel steel. The same gun was used and the projectiles were cast steel. The plates were placed one on the other, as in the case of the Cramp plates. The first shot was 28 ins. from the top and 16 ins. from the right-hand edge of the target, which was dished at the point of impact 1$\frac{1}{10}$ ins. The ridges on the plate, resulting from the mill scale, were slightly smoothed by the blow. There were no cracks and no bolts were broken. The second shot was 36 ins. from the top and 17 ins. from the left side of the target, dishing the plate 1$\frac{6}{10}$ ins. The third shot was at the center of the plate and was a duplicate of the first shot. The fourth shot was 32 ins. from the bottom of and 18 ins. from the right edge of the target, and dished the plate 1$\frac{8}{10}$ ins. The fifth shot was 32 ins. from the bottom and 14 ins. from the left edge, and produced results similar to those of the fourth shot.

The Carnegie plates were made longer than had been expected and there was not room under the structure to put the nuts on the lower row of bolts, and the bolts being merely driven down, allowed the bottom edge to curve up. This accounts for the deeper depression made by the lower shots than by the upper ones. One and four-tenths inches seemed to be about the normal depression. The tensile strength of the Carnegie plates was 92,000 to 102,000 lbs., and the elongation from 12 to 26%.

All of the 10 projectiles used were broken. No piece of shell was deflected more than 5% with the plane of the plate. The lateral dispersion was about 20%. The results of this test do not alter the position of nickel steel which still retains its superiority over the homogeneous metal. The ordnance authorities regard the Carnegie plates as better than the Cramp plates, taking into consideration, of course, the greater thickness of the former.

The Zinc-Tannin Process of Tie Preservation.

Mr. OCTAVE CHANUTE, well known in connection with methods of wood preservation, has lately examined some experimental railroad ties, of the most perishable kinds of wood, prepared by the zinc-tannin (Wellhouse) process in St. Louis in 1881 and 1882, and laid in the tracks of the Atchison, Topeka & Santa Fe R. R. at Topeka, Kan., and La Junta, Colo. After 9 or 10 years' exposure they show the following results for woods which would have lasted but from 1 to 4 years if unprepared:

EXAMINATION OF TIES AT TOPEKA, JULY 2, 1891.

Lot No.	Kind of wood.	No. of ties.	Date laid.	No. now in track.	Per cent. in track.	Time of exposure.
1	Colorado pine.	49	July 7, 1891.	Destr	oyed	by a wreck
6	Cottonwood...	87	Aug. 1, 1882.	43	49.4	8.92 years
7	Sweet gum...	51	Aug. 1, 1882.	10	19.6	8.92 "
8	Red oak.....	48	Aug. 18, 1882.	29	60 4	8.85 "

EXAMINATION OF TIES AT LA JUNTA, JULY 6, 1891.

Lot No.	Kind of wood.	No. of ties.	Date laid.	No. now in track.	Per cent. in track.	Time of exposure.
1	Black oak....	49	May, 1882.	49	100	9 1 years
2	White cotton-wood....	49	May, 1882.	47	96	9.1 "
3	Cottonwood..	50	May, 1882.	46	92	9.1 "
9	Colorado pine.	50	July, 1881.	50	100	10.0 "

Unprepared ties of the same kind of timber, laid at the same time, adjoining to these prepared ties, have all decayed and been taken up, while present appearances indicate that the prepared red oak, black oak and Colorado pine ties are likely to show an average life of 10 to 15 years or more. Former examinations of these ties indicated such favorable results that the A., T. & S. F. R.R. erected tie-treating works at Las Vegas, N. M., in 1885 to treat Colorado pine by the zinc-tannin process, and the Chicago, Rock Island & Pacific R. R. made a contract, in 1886, with the Chicago Tie-Preserving Co. to erect works in Chicago, and to treat hemlock ties by the same process. After five years' experience this contract has lately been renewed for an increased annual output. Each of the railroads mentioned now has in its tracks over one million of ties treated by the zinc-tannin process. It is found that not only does this process preserve ties against decay, but it hardens them as well. It is found on the C., R. I. & P. R. R. that, after three years' exposure, treated hemlock ties hold the spike as well and cut less under the rail than untreated white oak.

Machine Rock Drills and Hand Labor.

During the discussion on the paper on "Recent Trials of Rock Drills," by Messrs. Carbutt and Davey, read at the meeting of the Institution of Mechanical Engineers held on March 20 last, it will be remembered, says *Engineering*, that the question of the relative economies of hand work, as against machine drilling, arose. Mr. Arthur L. Collins, of Basinghall St., now adds some details of trials in connection with this question. The experiments were made in Norway in order to get comparative results of driving a level in exceptionally hard hornblendic gneiss by hand labor and by rock drill. The level was driven 6 ft. 6 in. × 6 ft. 6 in. in clear by four Swedish and Norwegian miners, working two shifts of two men each with about ten working hours per shift. The men were very skillful miners, but had no previous experience with rock drills. The hand-boring was all single-handed, ¾-in. steel and 4-lb. mallets being used. The rock drill used was a 3½-in. Cornish drill, with air at about 60 lbs. pressure. The best drill steel obtainable was used. If there was any change in the nature of the rock, it changed slightly for the worse during the trial; a fact which would be to the disadvantage of the machine work. The explosives used were dynamite No. 1 and gelatine dynamite. These, and all other materials used, were paid for by the men at cost price, but no charge was made to them for compressed air or for sharpening the borers in either case; neither is any allowance made in the figures here quoted for interest on capital or depreciation.

	Average driven per month.	Average cost per fathom of level.	Cost for dynamite and other materials.	Cost for labor.	Average wages earned per day.
	fathoms	£ s. d.	£ s. d.	£ s. d.	s. d.
Handboring, average of 5 months.....	3¼	5 6 0	1 11 10 (30% of total)	3 14 2 (70% of total.)	2 8
Rock drill, average of 7 months.....	4 fms. 5 ft	5 5 0	2 7 3 (45% of total.)	2 17 9 (55% of total.)	3 3

	Pounds of dynamite used per fathom of level.	Pounds of steel used per fathom of level.	Number of holes bored per fathom of level.	Average depth of hole.	Depth bored by each borer without sharpening.	Depth of holes bored per shift (one machine and two men)
	lb.	lb.	holes.	in.	in.	ft. in.
Hand-boring	20½	4⅜	.....	.....	.....	.....
Rock drill...	32½	7¾	32⅛	43⅛	4⅛	13 10⅛

* Including all time lost in blasting, etc.

Copper in the United States.

The United States is the largest copper producer in the world, says Census Bulletin No. 96. The output for the year 1889 was 226,055,902 lbs., or 113,028 short tons. The total sum expended in obtaining this copper was $12,062,180, of which $6,096,025 was paid in wages, $120,896 in salaries, $334,443 to contractors, $4,067,970 for materials and supplies, and $1,442,846 for taxes, rent, etc. The total capital invested is $62,623,228, and 8,721 men are employed in all grades.

The five leading states in this production are:

	Lbs.
Montana	98,222,444
Michigan	87,455,675
Arizona	31,386,185
New Mexico	3,686,137
Colorado	1,170,053

The New Water Supply of Newark, N. J.

In ENGINEERING NEWS of Oct. 11, 1890, there appeared a general description of the new water supply system for Newark, N. J., now being developed by the East Jersey Water Co. Through the kindness of Mr. CLEMENS HERSCHEL, Chief Engineer, further details of the work and its progress have been gathered and are presented below. To give a better understanding of the project some general statements are first made, at the risk of repeating what has already been given in the above named article.

The system under construction is designed to furnish the city of Newark eventually with a daily water supply of 50,000,000 galls. This supply will be delivered into the receiving reservoir at Belleville, above Newark, and the high-service reservoir on South Orange avenue, within the city, in such portions as may be deemed necessary to supply the low and high services, respectively. The contract provides for a maximum high-service supply of 25,000,000 galls. daily. Both of these reservoirs are already in use, the former receiving the supply now pumped from the Passaic River.

The East Jersey Water Co. will construct the works and transfer them to the city of Newark, together with water rights and right of way for the pipe line. The contract provides for the completion of the works by May 1, 1892. The total price is $6,000,000, but for 11 years the East Jersey Water Co. has the right to use and dispose of all water above 27,500,000 galls., daily. In return for this privilege one-third of the contract price, or $2,000,000, remains unpaid for the 11 years, and in addition the company operates the works and keeps them in repair during that period.

The supply will be from the headwaters of the Pequannock River, a tributary of the Passaic. There will be two large storage reservoirs, the Oak Ridge and Clinton, with capacities of about 2,500,000,000 and 3,500,000,000 galls., respectively; a small intake reservoir, called Macopin, and a 48-in. steel pipe line, connecting the latter with the Belleville distributing reservoir, named above.

The location of the several reservoirs, storage, intake and distributing, of the pipe line, and in addition the drainage area of the Pequannock River, the Passaic River and its other tributaries and the city of Newark was shown on a map in our issue of July 11.

THE PIPE LINE.

The pipe line is by far the most interesting part of the work and will be described first. It may be stated here that about half of the pipe, from the intake to the receiving reservoir, or some 10 miles, has been laid already, and that work is in progress on the remainder of the line.

This pipe line is of especial interest because it is the first steel pipe, at least of any size, to be laid in the East, and larger than any steel or wrought-iron supply conduit yet laid in this country.

The use of riveted wrought-iron pipe has been common in the Pacific States for many years, the largest being a 44-in. conduit in connection with the works of the Spring Valley Water Co., which supplies San Francisco. The use of wrought-iron and steel pipe has been necessary in the West, owing to the extremely high pressures to be withstood and the difficulties of transportation. As an example: In connection with the water supply of Virginia City and Gold Hill, Nev., there was laid in 1872, with Mr. HERMAN SCHUSSLER, San Francisco, Cal., as engineer, an 11½-in. riveted wrought iron pipe, a part of which is under a head of 1,720 ft., falling thus far in a distance of about 750 ft., from which point it rises to a level of 300 ft. below the starting point, the total length being about 37,100 ft. This pipe sustains, at the lowest point, a pressure of 46 lbs. per sq. in., where it is $\frac{5}{16}$ ins. thick. This conduit has a daily capacity of about 2,000,000 galls.

It is not necessary to multiply instances where the use of cast-iron pipe would have been wholly impracticable, nor to discuss further the merits of wrought-iron or steel pipe. Such pipe has been widely used in many parts of the West, but has not hitherto been used in the East to any notable extent.

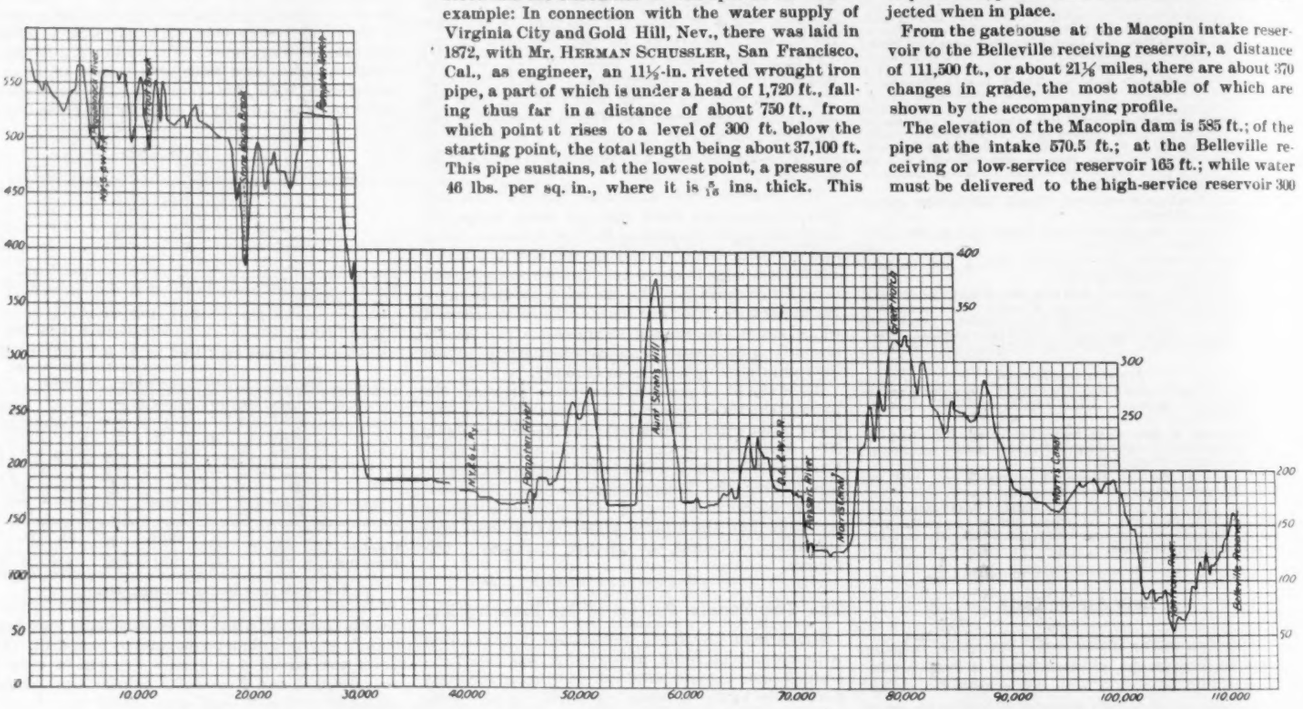
In the present case of 21 miles of 48-in. pipe laid in a mountainous region, some of it under 340 ft. head, the use of the more reliable metal was, practically, a necessity. Steel was chosen. Mr. HERSCHEL, the company's engineer, made a trip to California, studied the pipe in use there and designed the line now under construction, profiting by the experience of others and introducing some novel features of his own. The result is one of the most interesting and notable pieces of engineering work in the East, and, because of its size and new features, in the whole country.

The process of manufacturing the pipe was outlined in our issue of Oct. 11, 1891, and need not be described further here, except to state that the plates from which the pipe is made are about 13 ft. long by 7 ft. wide, open-hearth rolled steel. Four of these plates are used to make one section of pipe about 27 ft. long. The pipe is riveted longitudinally with a double row, and at the end joints with a single row of rivets of varying diameter, corresponding to the thickness of the steel plates. Before being rolled into the trench two of the 27-ft. lengths are riveted together, thus diminishing still further the number of joints to be made in the trench and the extra excavation to give room for jointing. All changes in the grade of the pipe line are made by 10° curves and all changes in line by 2½°, 5, 7½° and 10° curves. To lay on curved lines a standard bevel is used, and the different curves are secured by varying the number of beveled joints used on a certain length of pipe. To save expense 20% of the lengths may be made of plates less than 7 ft. wide, but the lengths of these sections must vary by multiples of the pitch of the rivets.

The thickness of the plates varies with the pressure, but only three thicknesses are used, ¼, $\frac{5}{16}$ and ⅜ ins., the pipe made of these thicknesses having a weight of 160, 185 and 225 lbs. per ft., respectively. All the steel is bought subject to rigid specifications, both of the chemical composition and as to physical tests. At the works all the pipe is tested to pressure 1½ times that to which it is to be subjected when in place.

From the gatehouse at the Macopin intake reservoir to the Belleville receiving reservoir, a distance of 111,500 ft., or about 21⅛ miles, there are about 370 changes in grade, the most notable of which are shown by the accompanying profile.

The elevation of the Macopin dam is 585 ft.; of the pipe at the intake 570.5 ft.; at the Belleville receiving or low-service reservoir 165 ft.; while water must be delivered to the high-service reservoir 300 ft. above the high-water mark of Newark Bay. The point of delivery at the first named reservoir is the high-water mark of the same, but at the second reservoir water is to be delivered 77 ft. above its high-water mark. The lowest point in the pipe line is at an elevation of but 66 ft. above tide, or 514.5 ft. below the intake, 109 ft. below the receiving reservoir and 244 ft. below the delivery point at the high-service reservoir. The other variations in grade will be mentioned further on, and may be seen by referring to the profile. The loss of head in the pipe line will be about 280 ft.



PROFILE OF PIPE LINE FOR NEWARK, N. J., WATER SUPPLY, FROM MACOPIN INTAKE TO BELLEVILLE RESERVOIR.

(Vertical scale 100 times horizontal.)

The pipe line and intake were designed to give sufficient head for delivery at the required points with as nearly a direct line as possible, there being but three especially notable changes in direction, and with the pipe laid to conform very nearly to the natural surface.

At 6,300 ft. from its starting point the pipe crosses beneath the Pequannock River at an elevation of 489 ft., having fallen about 81.5 ft. After various ascents and descents until 19,335 ft. have been traversed, it crosses beneath Stonehouse Brook at an elevation of but 384 ft., or nearly 200 ft. below the starting point. At Pompton Notch the pipe rises to an elevation of about 520 ft. In 2,700 ft. of length it descends 330 ft. to Pompton Plains. Thence across the plains to the Pompton River the fall is slight. The Pompton and the

Passaic Rivers are both crossed on bridges, the pipe being suspended by hangers from the upper chords.

Beyond Pompton River the line rises and falls about 100 ft. in a short distance, and further on, at an elevation of 166 ft., begins to climb Aunt Sarah's Hill. Here the pipe rises 210 ft. in about 2,400 and falls 207 ft. in a less distance. The summit of the hill is about 11 miles from the head of the line. The Passaic River is crossed at an elevation of about 130 ft. and Great Notch at 320 ft. In about four miles the line falls rapidly, passing under the Yantecaw River, about 20 miles from and 514.5 ft. below the starting point. In the remaining mile the line rises a little over 100 ft. to the Belleville reservoir.

Manholes are placed on the pipe line about 1,000 ft. apart, and there is an air valve, and in some cases two, at every summit. Blow-offs are located at proper intervals, and there are, in the whole line, nine 48 in. gates made by the Eddy Valve Co., Waterford, N. Y., for shutting off the water below their point of location, in case of emergency. On the whole line there are about 60 blow-offs and about 65 air valves and open pipes, the valves varying in size from 6 to 10 ins. and the open pipes from 8 to 12 ins. The open pipes are placed on the upper end of the line, at points where it approaches the hydraulic grade line. They rise from the top of the pipe, are carried horizontally for a few feet, then descend at an angle. There is an air vent on the upper side of the horizontal portion of the open pipe, to break possible siphon action. The air valves are covered in to prevent freezing; the side walls of the housing are double, to keep the inside warm, and air is admitted when needed through a flap door hung at the side.

One of the 48-in. gates is located about 5 miles from the head of the pipe line, at Stonehouse Brook; another on the Pompton Plains, about 7 miles from the intake, and another about 1¼ miles below, at Pompton River, before the crossing. The last gate is at the Passaic River, after the crossing.

A novel and interesting feature in connection with the large gates is an interlocking relief valve, designed to prevent too heavy strains on the pipe. The gate and relief valve are so combined that the gate cannot be closed until the relief valve has first been opened, and *vice versa*. This is the first instance of the use of the interlocking principle for such purposes which has come to our notice.

(To be continued.)

Tests of the Westinghouse Brake in South Australia.

We have recently received a copy of the official report of the Board appointed by the South Australian government in the spring of 1890 to inquire into the comparative merits of the Westinghouse Vacuum and other brakes. The members of the Board were Messrs. L. GRAYSON, M. P.; THOS. ROBERTS, Locomotive Engineer, South Australian Railways; J. QUAN, Manager Glenelg Railways; Allison D. Smith, Acting Locomotive Superintendent, Victorian Railways, and D. H. NEALE, Railway Inspector, New South Wales Railways.

The Board decided to make competitive trials of the various brakes and drew up a code of rules to govern the tests. The main features embodied in these rules were that any brake entering the competition must be continuous and automatic and capable of application by the "driver" or "guard." The trains to be tested were to be similar in all respects, to consist of not less than 50 vehicles of all classes and to be tested on the narrow-gage tracks. Brakeshoe pressures were not to exceed 95% of the weight on engine and tender wheels (except leading truck wheels) or 100% on wheels under other vehicles of the train, when said vehicles were empty; but one brakeshoe to each wheel was permissible except on the engine and tender, and the entire mechanism tested must be such as was intended for general use.

The trials were to be made first with brakeshoes hanging ¼ in. from the wheel tread and then with the shoe 1 in. from the wheel tread to represent the efficiency of the brake with half-worn blocks. The rolling stock was furnished by the Government railways; but each competitor was to furnish all the brake gear, apply it to his own satisfaction to the train, select trainmen to operate it from the South Australian railway service, and after not more than three days' private trial submit his train for tests during the first week in September, 1890. After the trials opened no competitor was to be permitted to alter, interfere with or repair the brakes on his train in any way. Each competitor was to bear the total cost of fitting up his train.

In response to the announcement of the Board, four companies declared their intention of entering the competition. They were the Vacuum Brake Co., the Westinghouse Brake Co., the Eames Vacuum Brake Co., and Messrs. Tadman & Barling. The last two companies, however, made no preparations for the tests. The representative of the Vacuum Brake Co. assented to all the conditions under which the tests were to be made and declared his company's willingness to compete in the trials. Two months afterward, however, he addressed a letter to the South Australian Government stating that his company objected to the conditions of the tests and would take no further action in the proposed competition.

The Board, however, decided to go on and make tests of the Westinghouse brake, as that company had already gone to considerable expenditure in preparing for them. On Oct. 8 the Board proceeded to Pittsburg, and the three days following were spent in conducting the trials.

APPARATUS USED IN THE TESTS.

The track where the tests were made was marked out as follows: On three separate portions of the line three posts were set up, marked respectively *A*, *B* and *C*. The distance between posts *A* and *B* was an accurately measured half-mile, and the distance from *B* to *C*, which was 1,000 yds., was divided into 30 spaces marked by intermediate posts, each representing 100 ft. We quote the following from the rules adopted by the Board:

4. To take the speed at the time of applying the test an observer stationed upon the engine will give an electric signal to the van containing the recording instruments when the trailing wheels of the engine are abreast post *A*, and the driver having run the distance from *A* to *B* at an even rate of speed will apply the brake when the center of the trailing wheel is opposite the stop post *B*. The time of passing posts *A* and *B* to be accurately taken by an observer on the engine.

5. At the instant that the train comes to a standstill the observer on the engine will again, with the stop-watch, record the time taken to bring the train to a stand.

6. The observers in the vehicle next the engine, immediately the train has come to a stand, will measure the distance from the center of the engine trailing wheel to the nearest marked distance post, thus obtaining the distance in which the stop was made.

7. The observer on the engine will note the steam pressure and air pressure immediately before the application of the brake, and also after its release. He will also note the influence of the application in the air gage.

8. A recording apparatus is placed in a vehicle at the rear end of the train, and will record graphically and automatically the movement of the driver's handle, the consequent change of pressure in the pipes and cylinders, and the time elapsing between the movement of the driver's handle and the full application at the rear of the train. It will also graphically record the time taken to release the brake and the speed and distance run.

9. The competitor shall declare his regular working pressure and leverage, in which no subsequent alteration must be made, and hand in drawings of the brake gear and fittings.

10. The running and working of the train shall be done solely by the driver, fireman and two guards, and no one else must assist or obstruct them in this duty.

11. The brake must be applied and released by the driver only, except where specially otherwise provided in these conditions.

12. Sand must not be used in any of the tests except in an unforeseen emergency.

13. Hand-brakes must not be used in any of these tests unless specially called for by the driver.

14. Any deviation from the four preceding conditions must be specially reported and noted.

15. All breakages or mishaps directly or indirectly caused by the brake will be recorded.

16. *No visitor will be allowed upon the engine or in the brakevan during the progress of the trials.*

The experimental train was made up as follows:

	Weight lbs.
Engine (14½ × 20-in. cylinders, 6 drivers, with leading truck)	56,200
Tender (6-wheeled)	28,080
20 goods wagons (4-wheeled) loaded	384,065
20 " " " partly loaded	316,315
7 " " " empty	56,675
3 carriages, bogie (8-wheeled) loaded	88,060
1 brake van (4-wheeled) loaded	25,340
Total weight of train	905,335

We quote from the official report of the Board the following statement of the points investigated in the tests and the results obtained:

In framing the trial tests the board kept in view the necessity of making experiments under the severest conditions that a rapidly-growing traffic would be likely to bring into operation, and endeavored so to conduct the trials that they fulfill the following essential conditions:

I. The behavior of the brake should, as far as possible, be tested under all the various conditions likely to arise in ordinary practice.

II. The brake should be tested so as to show its merits and defects under both ordinary and unfavorable circumstances.

III. The results obtained at the trials should be accurate, and checked by an electrical automatic indicator and by independent observations.

The board also specially directed its attention to the following points in regard to the Westinghouse brake:

(*a*) Complexity, especially of the triple valve, and consequent liability to become injured by dust and grit.

(*b*) Graduating power.

(*c*) Liability to become exhausted by repeated application.

(*d*) Time taken to release.

(*e*) Frequency of burst hosepipe.

(*f*) Liability of pump to fail.

The point (*a*) cannot be adequately tested in a trial of limited duration, but can be conclusively shown by extended experience, and we find on examining the Board of Trade returns of brake failures in Great Britain that failures of mechanism through grit, dust, and the presence of other foreign matter are exceedingly rare with the Westinghouse brake. In 1889, when 44,000,000 train miles were run with this brake, only one failure of this class is recorded—a pipe on a tender being partly blocked, through excessive use of oil having destroyed the inner layer of rubber in the hose coupling. This immunity from trouble from dust or dirt is due to the principle on which the brake works. Air is only admitted at the air-pump on the engine, and dust or grit admitted with the air is immediately deposited in the main reservoir of the engine and does not pass to the rest of the mechanism. On all other points of the train the outward pressure of the confined air tends to expel any dust or grit.

On the points (*b*), (*c*), and (*d*) the brake was subjected to the most severe tests we could devise. Repeated trials proved that a train heavy enough to require three engines on an ascending gradient could be safely taken down the steepest gradient on the narrow-gage lines of the colony—1 in 61—by one engine, the brake-power being entirely under the control of the driver, who could regulate the speed and stop when required. In one case, when descending this incline at an average speed of 15 to 16 miles per hour, a mob of cattle crossed the track directly in front of the engine. The driver immediately applied the brake with full force, stopping the train clear of the cattle—a stop impossible with the handbrakes at present in use, unless a number of brakes had been pinned down before leaving the summit. On the following day, when descending this gradient at 38 miles per hour, the train was stopped in a distance of 675 ft., as recorded by the indicator, showing the control the driver had over the train even when running down a steep gradient at a rate of speed which is considerably in excess of that allowed by the department.

The point (*c*)—liability to become exhausted by repeated application—was tried both by running down inclines and repeatedly applying the brake, and also by applying the brake at intervals of 30 seconds when a train was standing in a siding. In the former tests the pressure at the foot of the incline was invariably higher than at the summit, showing that the brake gained rather than lost power. In the latter test the pressure in the trainpipe fell 5 lbs. in six minutes; and on making a stop with the diminished pressure the train was stopped in 370 ft. when running down an incline of 1 in 80 at 34½ miles per hour, showing ample reserve power.

Point (*d*)—The release was quickly effected, the brake-blocks coming off all the wheels and the train starting from a state of rest in three seconds after the driver moved his handle to the release position.

Point (*e*)—The hosepipes do not frequently burst in Australia, and such failures may be minimized by the use of the highest quality of hose manufactured.

The point (*f*)—liability of the pump to fail—is reduced to a minimum by a systematic periodical inspection, as is proved by the small number of cases reported to this board or in the Board of Trade returns of England.

As the importance of the two latter points cannot be ascertained in trials of short duration, the conclusions of the board are based on evidence obtained from the experience of the locomotive departments of South Australia and Victoria. In the former colony three hosepipes burst in the last 12 months, and in the latter eight.

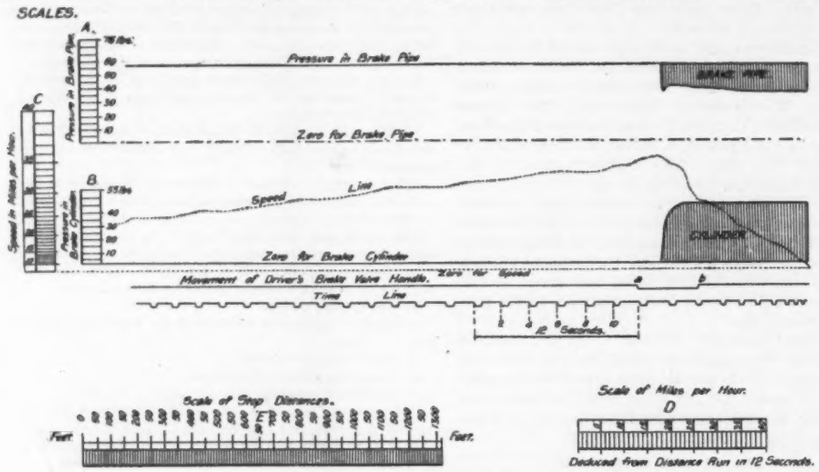
The brake was especially tested in the following respects:

(*a*) *The stopping power in an emergency* on the longest trains at maximum speed as shown in tests 1, 4, 5, 9, 14, 16, 19 and 20.—These tests contrasted with the hand-brake test No 21, show that the train could be stopped in less than

one-fourth of the distance on the level with continuous as against hand-brakes.

(b) *Efficiency of the brakes when the parts have become worn.*—All tests were made with the blocks hanging at least 1 in. from the wheel, representing a worn block.

(d) *Graduating power.*—This was tested by running a train down inclines of 1 in 61 and 1 in 80, and by making an ordinary service stop at Jamestown to bring the carriages exactly opposite the station. The speed of the train appeared to be easily regulated. On the first day of the trials several shocks were felt, but on the second and third days a great improvement in the graduating power was observed showing that the train was under thorough control.



Test 5. Emergency Stop, 50 Cars, Down 1 in 61.

EXPLANATION OF DIAGRAM, NO. 5 STOP.

1. On referring to Scale A it will be seen that while the train was in motion there was a pressure of 55 lbs. in the brake pipe at the rear van.

2. At point *a* the driver opened the valve to apply the brake, and shut it again at *b*, thus causing a reduction of 20 lbs. pressure in the brake pipe.

3. The pressure in the cylinder immediately rose to 45 lbs. See Scale B.

4. The time line shows that 1¾ seconds elapsed between the movement of the brake handle on the engine and the action of the brake commencing on the van in the rear of the train.

5 On referring the length of the indications made every two seconds to scale D, it will be seen that the speed was 35.5 miles per hour.

6. The speed line when the brake was applied, referred to Scale C, also shows 35 miles per hour.

7. The stop distance, measured between *a* and *c*, referred to Scale E, shows 205 yards, and is the distance the train traveled after the driver moved the brake valve handle on the engine.

8. The "speed line" is not so reliable as the "time line," and the indications of the latter have been preferred in determining the correct speed. The "speed line" is produced by somewhat complicated mechanism, while the "time line" is produced by a chronometer making marks by electric contact on an endless band of diagram paper driven from the van axle—a simpler and more reliable method, though the line produced is less graphic than the "speed line," which shows clearly the fluctuations of the speed of the train. The speed shown by the "time line" coincides closely with that obtained by stop watches on the quarter-mile posts. When running on the level the speed of the train before the stop was made was fairly constant, but when running down an incline the speed of the train was naturally constantly accelerating, and consequently the speed obtained in the quarter mile preceding the stop post was less than the speed obtained in the 12 seconds preceding the arrival at the post B where the brake was applied. Consequently in the stops on the level the speeds given by the recording instrument agree with those obtained by observers with stop watches, while in stops made on falling gradients the acceleration of the speed of the train is shown by the higher speed obtained by the instrument in the 12 seconds just before the stop post as compared with the speed obtained by the observer with a stop watch in the previous ¼ mile. In one case the speed was obtained in the 1,320 ft. preceding the application of the brake, while in the other it was obtained in about the last 200 to 600 ft. run before arriving at the stop post B, where the brake was applied.

9 The square depressions show the movement of the driver's handle in applying the brake, while the V-like depressions show the movement in the contrary direction to release the brake. Their effect on the speed will be seen by noticing the length of the intervals on the "time line."

(f) *Time taken in shunting.*—The result of this test proved that, with expert shunters, the time taken to shunt trucks fitted with the brake would be practically equal to that taken with wagons fitted with the ordinary hand-brake.

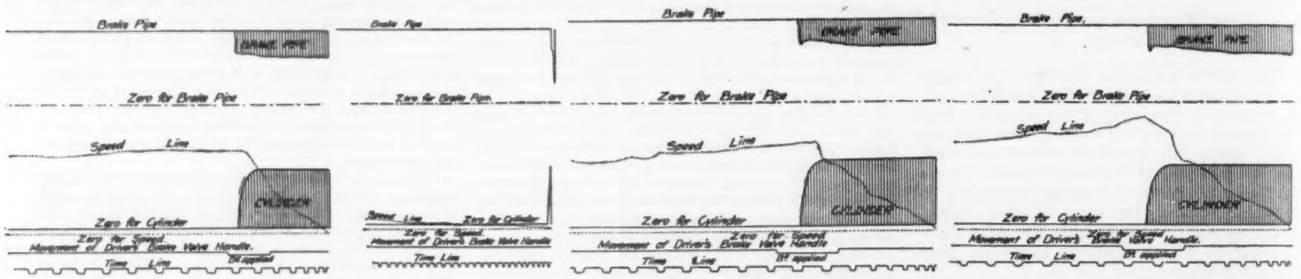
(g) *Consumption of steam in working the brake.*—This test was not of a conclusive nature, but evidence from engine-drivers goes to show that the steam used is not appreciable.

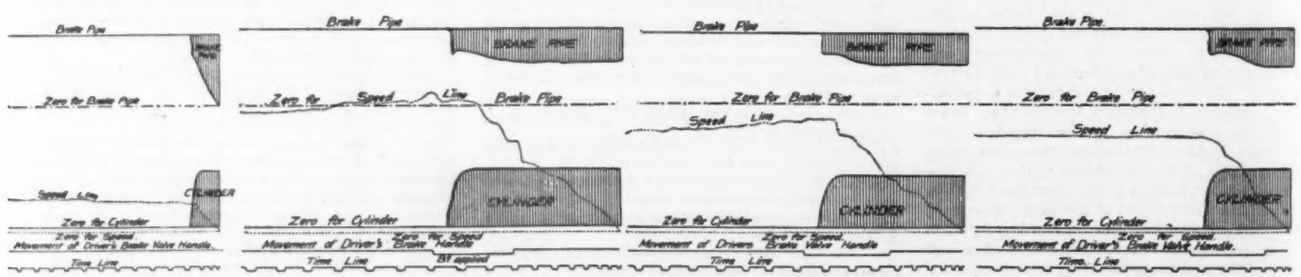
(h) *Liability to leakage and difficulty of detecting leakage.*—A pressure gage was applied to the cylinder of the brakevan only, which was found to leak off in 15 min. With one exception all the other brakes in the train remained on at the expiration of half an hour. The pressure during this latter period was reduced in the brakevan reservoir from 57 lbs to 26 lbs. In the cylinder the pressure fell from 47 lbs. to zero in 15 min., and in the trainpipe in the brakevan from 59 lbs. to 25 lbs. in 30 min. There were several leaks in the trainpipe, which might have been easily remedied if thought necessary. There was also a serious leak in the main reservoir on the engine, due to defective workmanship. (See test 12.)

Upon examination of the train after arrival at Jamestown on Oct 9 [before beginning the test] it was observed that four wagons had draw and buffing gear damaged, and these had to be detached before the return journey was commenced. The drawpins of nearly every vehicle were bent. The board considered that this injury was due to the excessive length and weight of the train, which required three of the most powerful 3 ft. 6 in. gage engines in the colony to work on 1 in 61 gradients, and also to some extent to the sudden application of the brake in emergency stops, and the inexperience of the driver on the first day of the trials.

The times, distances, pressures and speeds were taken by Kapteyn's automatic recording apparatus, which, by means of several Richards' indicators, automatically drew diagrams of the pressures and speeds on an endless sheet of paper driven from an unbraked axle of the rear van. These diagrams gave the distance traveled by the train. The time was shown by a clock in connection with an electric contact apparatus marking the paper at intervals of two seconds. The movements of the driver's brake-valve on the engine were similarly shown, each movement making and breaking an electric contact, the engine and apparatus being electrically connected by a wire along the train. Telephonic communication between the engine and the rear van was found convenient, but was not used in making records of the results of the tests. The instrument was in the sole charge of Mr. OXLADE, representing Messrs. H. H. Kingsbury & Co., electrical engineers, of Sydney, New South Wales.

The speeds, distances, times and pressures were checked by independent observations, the speed being ascertained by noting with stop-watches the time taken to run between the quarter-mile posts. The distances in which the stops were made were measured by a tape from the point


Brake Pipe
Zero for Brake Pipe
Speed Line
CYLINDER
Zero for Cylinder
Movement of Driver's Brake Valve Handle
Time Line
Test 1. 50 Cars; Level.
Test 2. 50 Cars; Up 1 in 80.
Test 4. 50 Cars; Down 1 in 61.
Test 5. Down 1 in 61.


Brake Pipe
Zero for Brake Pipe
Speed Line
CYLINDER
Zero for Cylinder
Movement of Driver's Brake Valve Handle
Time Line
Test 15. 30 Cars; Up 1 in 80.
Test 16. 30 Cars; Down 1 in 61.
Test 19. 30 Cars; Down 1 in 80.
Test 21. 30 Cars; Level.

(c) *Efficiency of the brake should a coupling part.*—This was tested in various speeds on the level and on up gradients of 1 in 80 and 1 in 61. In all cases both portions of the train were brought to a stand in short distances, and in all cases but one a space of several feet separated the two parts of the train when they came to rest. In one test the two parts came together, but not violently. (See tests 2, 7, 10, 15 and 18.)

(e) *Time taken to release.*—This was carefully ascertained when the train was standing in the siding. The time taken was remarkably short, not exceeding three seconds.

at which the brake was applied to the point at which the train came to a stand.

In the accompanying tables I. and II., and in the diagrams, a full statement is given of the emergency and breakaway stops. The Westinghouse brake is too familiar to Americans for the tests of "graduating power," or the capacity of the brake to regulate

TABULATED STATEMENT OF BRAKE TESTS, CONDUCTED BETWEEN PETERSBURG AND JAMESTOWN, ON THE SOUTH AUSTRALIAN RAILWAYS.

TABLE I.—EMERGENCY STOPS.

No. of Test.	Date. 1890.	Speed, miles per hour. Previous quarter mile, Observers.	Speed, miles per hour. When brake was applied, Instrument.	Time from driver moving handle, seconds. To full stop.	Time from driver moving handle, seconds. To brake going on in rear van.	Time from driver moving handle, seconds. To brake being full on in rear van.	Distance, ft. Measured by tape.	Distance, ft. Recorded by instrument.	Gradient.	Pressure of air, lbs. Train pipe. Engine.	Pressure of air, lbs. Train pipe. Rear van.	Pressure of air, lbs. Cylinder rear van.	Train. No. vehicles, including brake van.	Train. Total w'ght, tons.	Train. Total l'ngth, ft.	Train. ¶Percentage of w'ght brak'd.	‡Equivalent percentage of retardation on level. On whole train, %.	‡Equivalent percentage of retardation on level. On braked weight, %.	Equivalent distance in which a similar train could be stopped when traveling at 40 miles per hour down a gradient of 1 60, ft.
1	Oct. 9..	30.0	32.0	13½	1¾	2½	395	376	level	57	53	45	50	415	942	58	9.67	16.67	710
4	Oct. 9..	34.3	35.0	18	1½	2¾	559	585	down 1-61	60	60	48	50	415	942	58	9.07	15.64	768
5	Oct. 9..	35.0	35.5	18½	1¾	2¾	580	615	down 1-61	56	55	45	50	415	942	58	8.92	15.38	783
9	Oct. 9..	30.0	....	12½	...	...	343	...	level	57	55	..	46	390	876	50	9.31	15.78	744
11*	Oct. 10.	33.3	33.5	14	...	...	390	405	level	55	53	44	30	269	609	65	9.84	15.14	695
16	Oct. 10.	38.0	38 5	21	1	2¼	643	675	down 1-61	55	55	44	30	269	609	65	9.43	14.51	732
19†	Oct. 10.	34 5	34.8	19½	1	2¼	570	588	down 1-80	50	50	40	30	269	609	65	8.56	13.17	824
20	Oct. 11.	34.5	33.5	13	1	2¼	377	375	level	57	55	46	30	269	609	65	10.63	16.35	634
21	Oct. 11.	32.0	....	64	...	...	1,683	...	level	H'd br'ks only used.			30	269	609	18	2.16	12.00	11,592

* Brake applied from rear van.

† Pressure same as after exhaustion test No. 11.

‡ The influence of the revolving parts has been allowed for in calculating the percentage of retardation.

All trials were made with brakeblocks hanging at least 1 in. from wheels, so as to represent the effect with worn blocks.

The boiler pressure was about 120 lbs. per sq. in. in all cases.

The average results obtained in all emergency stops where both methods observation and instrument—were employed, are as follows:

	Speed, miles per hour.	Distance of stop, ft.
Observation	34.1	502
Instrument	34.7	517

The speed given by the instrument is that immediately preceding the stop, when, especially on falling gradients, the train is gaining speed.

The speed as taken by observers is that in the ¼ mile preceding the stop, when the train has generally not reached its highest velocity. The speed obtained by the latter method is therefore somewhat lower.

The distance obtained by the instrument is electrically recorded from the first movement of the driver's handle, while the distance as measured by tape is taken from the stop post at which the brake should be applied. In this case, however, the driver appears to have applied his brake on the average about ½ second before being exactly abreast of the stop post, the longer distance given by the instrument being the more correct.

[¶ As brakes were applied to every wheel of the train except the engine-truck wheels, this column is really the percentage which the total brakeshoe pressure was of the total weight of the train.—ED.]

TABLE II.—BREAKAWAY TESTS.

No. of Test.	Date, 1890.	Speed, miles per hour.	Gradient.	Distance run to stoppage of rear portion of train. From coupling being slipped. Secs.	Ft.	From hose pulling apart. Secs.	Ft.	Distance between two portions when train came to a stand.	No. of vehicles in train.	No. of vehicles attached to engine.
2	Oct. 9.....	6	up 1-80	..	..	....	2.0	12 ft. 10 ins.	50	22
7	Oct. 9.....	5	up 1-61	8	..	....	1.6	8 ft. 7 ins.	46	21
10	Oct 9.....	25 (?)	level	.	248	13	....	touched	46	21
15	Oct. 10	21½	up 1 80	..	..	..	165	37 ft.	30	18
18	Oct. 10	14	up 1-61	..	..	5	68	18 ft. 10 ins.	30	18

the speed when running down a long incline, to be of much interest. The same may be said of the time taken to release, time taken in "shunting," consumption of steam in working the brake (or air-pump) and liability to leakage.

In closing its report the Board affirms that "a continuous brake is necessary and should be fitted with the least possible delay to all rolling stock. The Westinghouse brake is already in considerable use in the three colonies of South Australia, Victoria and New South Wales. The Board is of opinion that the brake which they have subjected to such severe tests is an excellent one, and likely to prove satisfactory in actual service. The Board therefore recommends the adoption of the Westinghouse quick-acting automatic brake as the standard brake for the colony, or of any other that may afterward be proved to be superior that will couple and work with it."

Two of the members of the Board, Messrs. ROBERTS and QUAN, dissented from part of these conclusions and recommendations. The former recommended that the Westinghouse automatic quick-acting brake be applied to all the 5 ft. 3 in. gage rolling stock, and that the adoption of a standard brake for the 3 ft. 6 in. gage lines be deferred until the completion of the competitive trials soon to be made in New South Wales. Mr. QUAN recommended that the Westinghouse ordinary automatic brake be adopted as the uniform standard continuous brake for the South Australian Railways, but that ordinary handbrakes only be used in goods and mineral traffic. His reason for favoring the ordinary automatic brake over the quick-acting was the very astonishing one that the lightly constructed rolling stock of the narrow-gage lines would be much damaged by the universal adoption of the quick-acting brake. An examinasion of the records of American brake trials and brake practice would be apt to lead to a radical alteration of his views.

A noticeable feature of these tests is the great amount of slack, it being required that the brake-shoes should be 1 in. from the wheel tread when the brake was off. With the 4-wheel narrow gage cars, however, the short and stiff connections necessary for the efficiency of the brake with this slack were much more easily obtained than would be possible on an ordinary American freight car.

PERSONAL.

Mr. F. N. FINNEY has been elected President of the St. Paul, Minneapolis & Sault Ste. Marie Ry. Co., and Mr. F. D. UNDERWOOD General Manager.

Mr. H. C. POTTER, General Manager of the Flint & Pere Marquette R. R., has resigned, and Mr. WILLIAM H. BALDWIN, Jr., has been appointed to succeed him. Mr. BALDWIN'S office is at Saginaw, Mich.

Mr. SUMNER J. COLLINS has been appointed Superintendent of the Louisville, New Albany & Chicago R. R. Co., with headquarters at Chicago. He was formerly Division Superintendent on the Chicago, Milwaukee & St. Paul.

Mr. OCTAVE CHANUTE, well known for his long-continued study of the methods of wood preservation, is making this subject a specialty, and, in connection with the Chicago Tie-Preserving Co., is prepared to design, erect and operate works for preserving wood.

Mr. DAVID BROWN has resigned his position as General Manager of the West Shore fast freight line, and will be succeeded by Mr. JAMES MCQUEEN, Jr., whose headquarters will be at Detroit. Mr. BROWN continues as Assistant General Freight Agent of the Chicago & Grand Trunk Ry. Co.

Mr. RICHARD POTTS, C. E., who died recently in Chicago, was born in Baltimore in 1831, and went to Chicago in 1855. From 1863 until his death he was connected with the Chicago Board of Public Works. He was educated at Elicott City, Md., and, after a successful course of civil engineering, was engaged in the construction of the James River & Kanawha Canal. He was one of the earliest members of the American Society of Civil Engineers.

NEW PUBLICATIONS.

—*Landscape Gardening.* By SAMUEL PARSONS, Jr. New York, 1891; G. P. Putnam's Sons. Cloth, 7×10 ins., pp. 329; numerous illustrations. Price, $3.

The author has been for 10 years Superintendent of Parks for New York City. Any one who is familiar with Central Park will need no other evidence of Mr. Parsons' qualifications for discussing the subject. This work, however, does not treat wholly, or even mainly, of the management of large tracts of land, nor of landscape gardening in its broadest sense. It is rather a practical treatise on lawn planting, giving useful instruction to the owner of a lot with fifty feet frontage, as well as to the possessor of a nestate needing more ambitious treatment.

Mr. Parsons gives very little space to road and path making and to drainage, which things he rightly considers to be more within the province of the engineer. The book begins with valuable chapters giving in detail the methods of cleaning, grading and planting lawns. Then follow six chapters describing minutely, and often enthusiastically, the trees and shrubs that may be used in temperate climates, and the effects they produce upon the lawn in different seasons of the year. Three more chapters take up in a similar way gardens and garden flowers. There are also practical chapters treating especially of small places; a chapter on the ornamentation of ponds and lakes; a chapter on city parks; and one on railway and cemetery lawn planting. The index is full and well arranged.

The numerous illustrations from photographs are excellent, and, if many of the small cuts of plants remind one of trade catalogues, they at least show clearly the character of the plants, and are made small enough not to obtrude themselves on the page. The book is printed on fine paper in large, clear type, and is very tastefully bound.

—*Internal Commerce of the United States.*—The Industrial, Commercial, Transportation and other Interests of the Pacific Slope: Alaska, Arizona, California, Idaho Nevada, Oregon, Utah and Washington, by S. G. BROCK, Chief the Bureau of Statistics, Treasury Department, Washington. 1891, Government Printing Office. 6×9 ins., pp. 1,174.

This volume is very much more interesting than the average public document. It contains a fairly complete description of the industrial and commercial position of each state named in the above list, and the descriptions are generally very well written. The states covered by the report contain probably more undeveloped natural resources than any other part of the United States, and, while the report evidently does not err by undervaluing these it is probably as temperate and conservative a description of this section as can be found in print.

—*Die Untersuchung von Feuerungs—Anlagen.*—Eine Anleitung zur Anstellung von Heizversuchen. By HANNS FREIHERR JUEPTNER VON JONSTORFF, Chemist of the Austrian Alpine Mining Co., Vienna, Pest and Leipzig, A. Hartleben. Paper, 12 mo., pp. 511, 49 cuts and 67 tables. $1.50.

The object of this work, which is intended to give the reader a thorough introduction into the methods of conducting tests of the heating power of fuels and allied subjects, calls for an extensive treatment of the physical and chemical laws underlying such investigations. But the limits of one volume restrict the author to a study of a number of typical investigations which cover fairly well the general field of such work, whose great extent precludes more detailed treatment. These, however, suffice to fulfil the aims of the book, since a detailed description of all varieties of heating plants would be out of place. The greatest value of the book to the practical physicist lies in the tables in the appendix, many of which are absolutely indispensable and others highly desirable in such investigations. The author probably aimed to make this part of the book as complete as possible, and any person who has had occasion to hunt through several works for the matter here collected will undoubtedly consider an investment in this work quite profitable. Nevertheless it is difficult to say with certainty whether the data given here will answer in all the great variety of tests of heating power. A special index to the tables adds considerably to the value of this portion of the book, which appears to be valuable in every respect, and deserving the neat form in which it appears.

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COMING TECHNICAL MEETINGS.

American Society of Swedish Engineers.—Aug. 1. At 250 Union St., Brooklyn, and 347 North 9th St., Philadelphia.

Civil Engineers' Society of St. Paul.—Aug. 3. Secy., C. L. Annan.

Western Society of Engineers.—Aug. 5. Secy., J. W. Weston, 230 La Salle St., Chicago.

Engineers' Club of St. Louis.—Aug. 5. Secy., Arthur Thatcher, Room 801, Odd Fellows' building.

Engineers' Club of Minneapolis.—Aug. 6. Rooms, Public Library Bldg. Secy., F. W. Cappelen.

Association of Civil Engineers of Dallas.—Aug. 7. Secy., E. K. Smoot, 803 Commerce St.

Technical Society of the Pacific Coast.—Aug. 7. Secy., O. von Geldern, 319 Market St., San Francisco.

Engineers' Club of Kansas City.—Aug. 10. Rooms, Baird Building. Secy., H. Goldmark.

Atlanta Society of Civil Engineers.—Aug. 11. Secy., Parker N. Black, Room 39 Capitol Block.

Civil Engineers' Club of Cleveland.—Aug. 11. Secy. A. H. Porter, 50 Euclid Ave.

Denver Society of Civil Engineers.—Aug. 11. "Sewer Construction." Secy., Geo. H. Angell.

Atlanta Society of Civil Engineers.—Aug. 11. Secy., P. N. Black, Rooms 39 Capitol Block.

Civil Engineers' Association of Kansas.—Aug. 12. Secy., J. C. Herring, Wichita, Kan.

Engineers' Society of Western Pennsylvania.—Aug. 18. Secy., J. H. Harlow, Pittsburg, Pa.

Engineers' Club of Cincinnati.—Aug. 20. Secy., J. F. Wilson.

Scandinavian Engineering Society of Chicago,—Aug. 20. Secy., T. G. Philstedt, 112 Adams St.

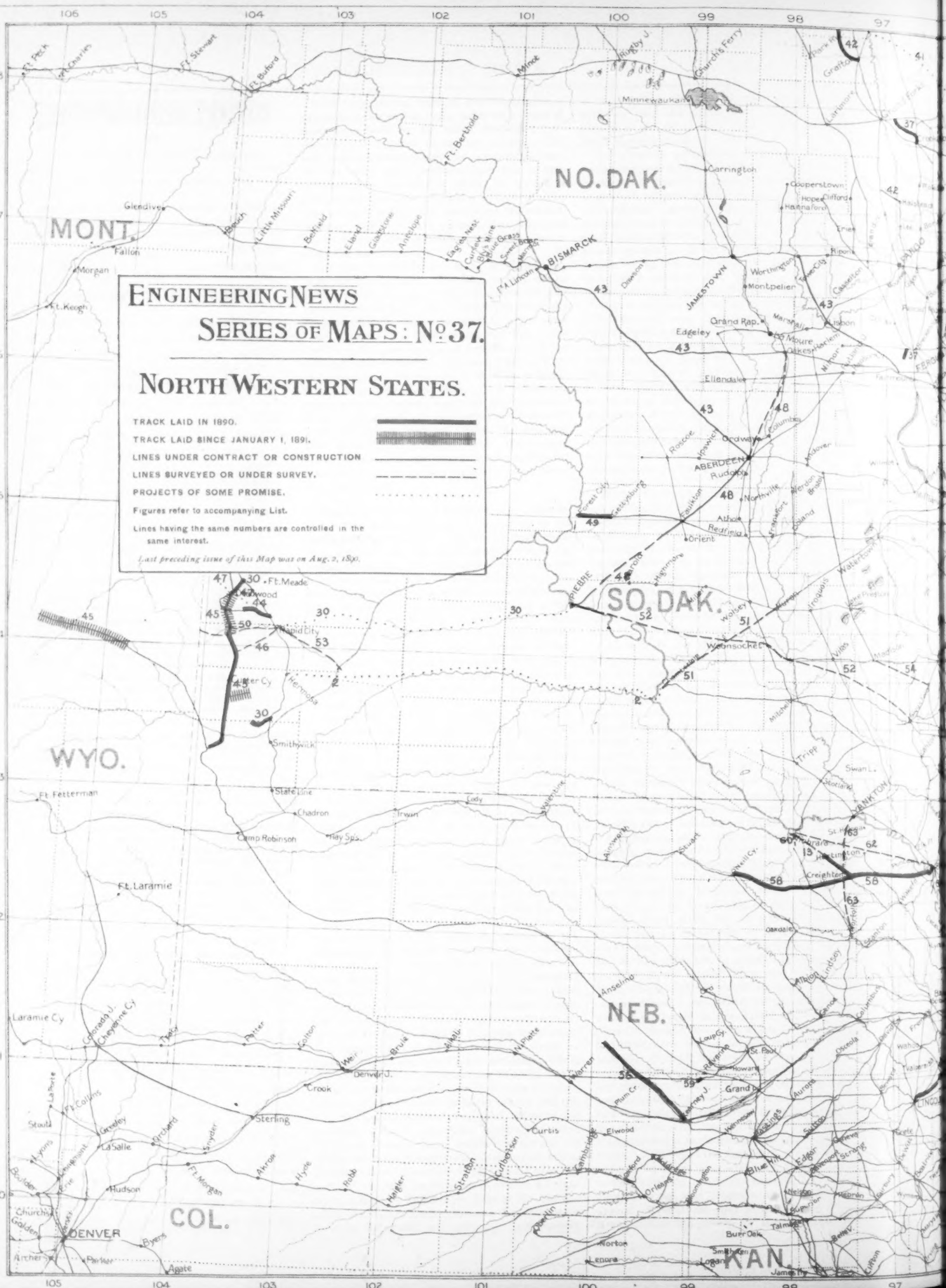
SOME very careful tests of the Westinghouse automatic quick-acting brake made by a board of experts appointed by the South Australian government are recorded in another column. The tests were originally planned as competitive tests, but the other brake manufacturers who at first signified their intention of fitting up a train to take part in the tests afterward withdrew. The tests on the Westinghouse train were carried out, however, with more care, perhaps, than if the test had been competitive, since there was ample time to make the tests thorough.

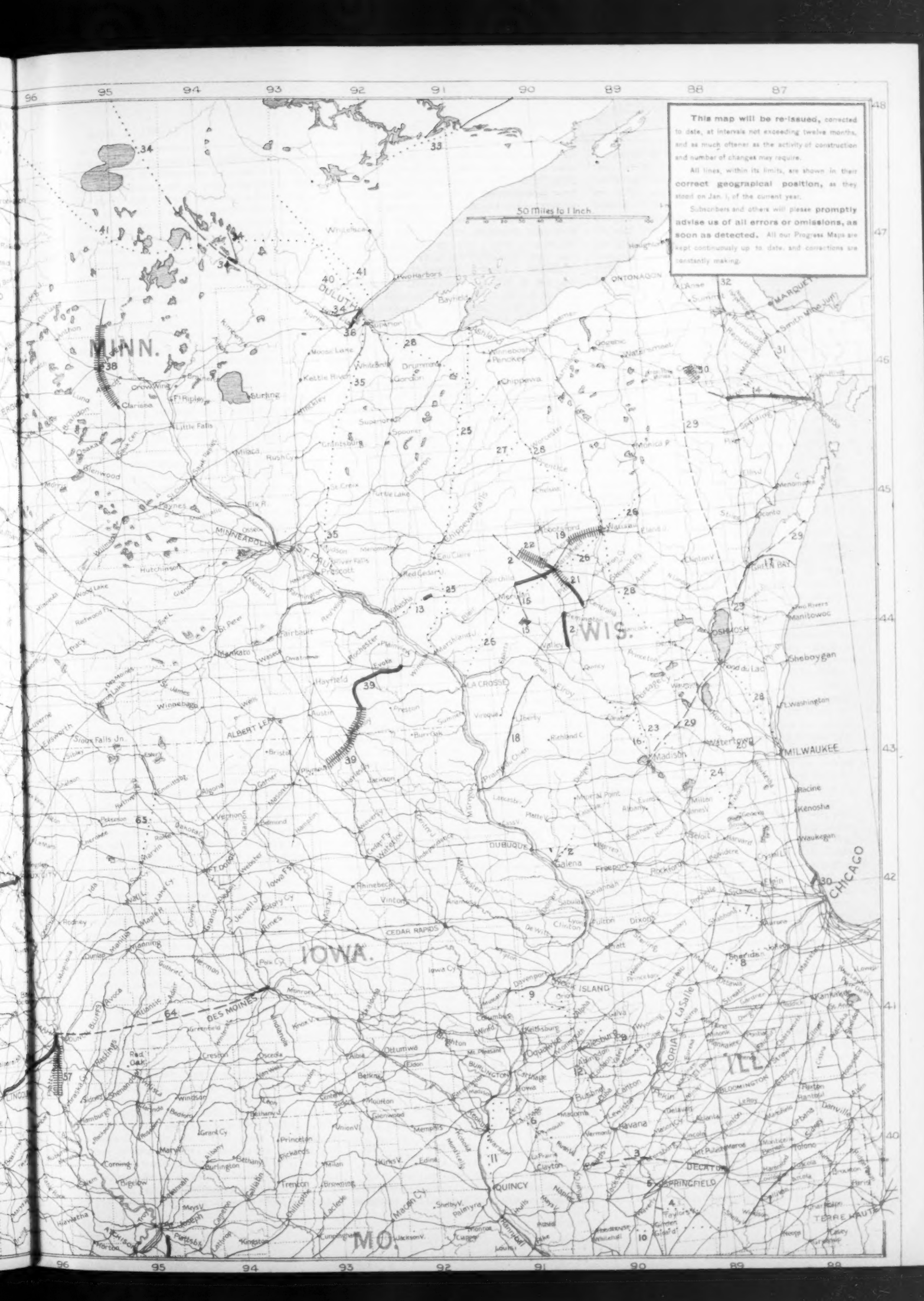
The tests were made on a train of 50 narrow-gage cars of all classes. The total length of the train was 942 ft., and the total weight 415 tons (presumably of 2,240 lbs.). With this train the brake went on in the rear in van in 1¼ to 1¾ seconds from the time the engineer moved the brake handle. The percentage of retardation of the brakes on the whole train was from 8.92% to 9.67% of the total train weight, and from 15.38% to 16.67% of the total brakeshoe pressure. A remarkable requirement in the tests was that the brakeshoes should hang at least *one inch* from the wheel tread when the brakes were off. With the short and stiff connections possible with narrow-gage 4-wheeled cars this seemingly difficult requirement was met, and an extremely satisfactory performance was shown.

WHILE serious railway accidents are comparatively rare on the Continent, owing mainly to low speed, excellent roadbed, absence of grade crossings, and, as a rule, exceeding caution in handling trains, when they do occur certain other elements combine to make them especially disastrous. The Moenchenstein accident, which we describe in this issue from material gathered on the spot a few days after the wreck by a member of this staff, cost between 70 and 80 lives, and the late accident at St. Mandé, in France, adds 50 more to the record for one month in France and Switzerland alone. In both cases excursionists, and not passengers by the regular train, were the victims, though the only effect this fact had upon the Swiss accident was the imposing of two heavy locomotives and an unusually crowded train upon a bridge which was certainly not above suspicion in design. From the meager accounts of the later French disaster, this was either a case of blundering in the transmission of a signal or was due to the failure of certain signaling apparatus. But in both cases the comparatively light construction of the cars had considerable to do with the loss of life. The Swiss cars concerned had 4 axles, a length of 49.2 ft., a seating capacity of 70 passengers, and a weight for the car alone of 14 tons. This, when compared with an American car of 46.5 ft. in length, seating 51 passengers and weighing 20 tons, shows that the lacking 12,000 lbs. was mainly in the body of the Swiss car. As shown in the photographs given with the article on the Moenchenstein accident referred to, the wreckage of 7 cars of all classes takes up but little vertical height, plainly indicating how complete must have been the collapse of the sides of these cars, and how little chance the passengers within had for escaping. This same lightness of construction also furnishes excellent kindling wood when fire is in any way communicated to the wreck, as was the case in the later French accident. While we have no plans showing the framing of the Swiss cars in this particular wreck, their complete collapse is a proof that the heavy trusses and ties and the solidly framed uprights between the windows usual in American construction must have been absent. As an evidence of the marked difference in the strength of the coupling devices of Continental and American cars referred to in the account, we have the story this week that a freight car in a train on the Georgia Central Ry. lost one of its trucks completely, and ran for some miles with the end of that particular car held up only by the coupling. We tell the story without othe evidence than the usual press account; but it illustrates the value of a strong connection between the cars of a train.

The extreme deliberation displayed by the Swiss engineers in closing a gap in an important trunk line is another marked feature of difference in methods between themselves and their American brethren. About 23 days, according to the account given, was deemed necessary before the road could be put into a condition for even temporary operation. It only required a few days longer for the Pennsylvania R. R. Co. to restore to service 8 miles of their main line obliterated by the terrible Johnstown flood of May 31, 1889. And in a very late case on the Louisville & Nashville Railway near New Orleans, where the sinking of the track in a swamp necessitated the building of a new trestle longer than the Swiss bridge, about 8 hours was all that the regular trains were delayed; and the passengers grumbled at that. Had the accident referred to occurred on an American line 48 hours would have been an abundance of time in which to put up a strong timber structure, to have shifted the tracks and to have opened the line to traffic; and then the superintendent would not have especially prided himself upon the feat accomplished.

WITH two so-called polar expeditions already out and another about to set out, the article of Dr. NANSEN, elsewhere given in abstract, is interesting as pointing to a novel route, and a method of reaching the North Pole that depends upon the blindest chance for its realization. The theories of Dr. NANSEN are ingenious, and he evidently has the courage of his convictions and is ready to brave dangers that would appal most men. But we are inclined to side with Gen. GREELY in his criticism of Dr. NANSEN'S plans. These criticisms first of all refer to the ship he is building, which he believes will withstand the nip of the ice floes in this great frozen sea. He may succeed in getting through just as the *Jeannette* survived similar dangers for two long years—until the particular nip came that crushed her. But when we consider the untold dynamic force stored in a moving ice field that contains many millions of tons of material, it would seem impossible that any floating structure that man could devise or construct would withstand the resultant pressure. Even if the ship were lifted by the peculiar form of her hull, the stories told by many Arctic explorers of the wild riot of breaking ice fields, the upheaving and piling up of ice and the dangers of overhanging masses leave the chances for her survival infinitesimally small. With regard to the floating articles from the *Jeannette*, Gen. GREELY and Commodore MELVILLE both "doubt the facts," like the Scotchman of fame. But the gravest doubt of all lies in what Dr. NANSEN would find in the vicinity of the Pole, were he ever fortunate enough to get that far. The late Dr. W. B. CARPENTER, of *Challenger* fame, and a scientist of the highest authority, supposes an Arctic ice cap and an extensive land area as the only explanation possible for the enormous thickness of ice found in the Arctic regions. Gen. GREELY himself has seen a flat-topped iceberg that must have been from 800 to 1,000 ft. thick; and the origin of this heavy ice thus indicated is certainly far more reasonable than the theory that any abnormal thickness is due solely to its drift past the pole in the short space of a few years. In fact this theory of Dr. NANSEN is wholly untenable in connection with the heavier ice floes seen by MACLURE and others coming from the "unknown North." To depict the dangers of a drift in open boats or upon ice floes, which Dr. NANSEN seems to treat so lightly, we do not need the evidence of GREELY or the boat journeys of the *Polaris* and *Hansa*. Even those who know nothing of the Arctic regions can picture for themselves the hor-


ENGINEERING NEWS
SERIES OF MAPS: No. 37.
NORTH WESTERN STATES.
TRACK LAID IN 1890.
TRACK LAID SINCE JANUARY 1, 1891.
LINES UNDER CONTRACT OR CONSTRUCTION
LINES SURVEYED OR UNDER SURVEY.
PROJECTS OF SOME PROMISE.
Figures refer to accompanying List.
Lines having the same numbers are controlled in the same interest.
Last preceding issue of this Map was on Aug. 2, 1890.
NO. DAK.
SO. DAK.
MONT.
WYO.
NEB.
COL.
KAN.
BISMARCK
ABERDEEN
PIERRE
DENVER
Minot
Carrington
Jamestown
Watertown
Huron
Sioux Falls
Yankton
Rapid City
Deadwood
Ft. Meade
Ft. Fetterman
Ft. Laramie
Sterling
Denver J.
Crook
Anselmo
Grand I.
Hastings
Kearney J.
Creighton
Norfolk
Wayne
Omaha
Lincoln
Beatrice
Fairbury
Hebron
Superior
Nelson
Oberlin
Norton
Phillipsburg
Smith Cen.
Logan
Talmage
Beaver
Buer Oak
Glendive
Fallon
Morgan
Ft. Keogh
Ft. Peck
Ft. Buford
Ft. Stewart
Ft. Berthold
Minnewaukan
Devils Lake
Grafton
Cooperstown
Hope
Hannaford
Clifford
Erie
Ripon
Worthington
Montpelier
Edgeley
Grand Rap.
Ellendale
Columbia
Groton
Redfield
Orient
Athol
Northville
Frankfort
Forestburg
Highmore
Wolsey
Wessington Springs
Woonsocket
Miller
Tripp
Swan L.
Stotland
Irene
Vilas
Iroquois
Lake Preston
Volga
Brookings
Arlington
Madison
Canton
Elk Point
Vermillion
Meckling
Tabor
Lesterville
Scotland
Parker
Marion
Freeman
Menno
Milltown
Tyndall
Armour
Wagner
Platte
Geddes
Academy
Mission
Winner
Colome
Gregory
Burke
Witten
Dallas
Presho
Reliance
Lower Brule
Chamberlain
Oacoma
Kennebec
Lyman
Okreek
Martin
White River
Valentine
Merriman
Gordon
Rushville
Hay Springs
Chadron
Crawford
Harrison
Camp Robinson
Irwin
Lody
Newcastle
Upton
Moorcroft
Sundance
Aladdin
Hulett
Alva
Beulah
Belle Fourche
Sturgis
Piedmont
Rapid City
Hermosa
Custer Cy
Smithwick
Edgemont
Oelrichs
Hot Springs
Provo
Buffalo
Kaycee
Shawnee
Douglas
Glenrock
Orin
Wendover
Cheyenne
Laramie Cy
Colorado J.
Tracy
Potter
Colton
Bruia
Meir
Ft. Morgan
Akron
Hyde
Robb
Haigler
Stratton
Carlinton
Curtis
Elwood
Cambridge
Oxford
Orleans
Bloomington
Blue Hill
Edgar
Fairfield
Strang
Geneva
Exeter
Milford
Seward
Utica
Staplehurst
Garland
Wahoo
Ashland
Weston
Prosser
Valley
Waterloo
Elkhorn
Omaha
Council Bluffs
Missouri R.
Niobrara
Verdigre
Creighton
Norfolk
Wayne
Pierce
Plainview
Oakdale
Lindsay
Albion
Genoa
Columbus
Schuyler
Fullerton
Central City
Grand I.
Aurora
Hastings
Kearney J.
Gibbon
Shelton
Wood River
Alda
Doniphan
Grand I.
Howard
St. Paul
Loup City
Arcadia
Ord
North Loup
Burwell
Ericson
Taylor
Greeley
Spalding
Cedar Rapids
Boone
Albion
Primrose
Humphrey
Lindsay
Platte R.
Loup R.
Elkhorn R.
Niobrara R.
Republican R.
Arkansas R.
Missouri R.
Big Muddy
Blue Grass
Sweet Brier
Eagles Nest
Curlew
Big Mine
Warrick
Antelope
Gladstone
Eland
Bellfield
Little Missouri
Beach
Glendive
Dawson
Jamestown
Montpelier
Worthington
Ripon
Cassleton
Lisbon
Harlem
Wilton
Oakes
Moore
Marshall
Grand Rap.
Edgeley
Columbia
Ordway
Roscoe
Ipswich
Aberdeen
Rudolph
Northville
Frankfort
Forestburg
Highmore
Wolsey
Woonsocket
Redfield
Orient
Athol
Groton
Stratford
Andover
Watertown
Huron
Sioux Falls
Yankton
Vermillion
Elk Point


This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.
All lines, within its limits, are shown in their correct geographical position, as they stood on Jan. 1, of the current year.
Subscribers and others will please promptly advise us of all errors or omissions, as soon as detected. All our Progress Maps are kept continuously up to date, and corrections are constantly making.
50 Miles to 1 Inch
MINN.
IOWA.
WIS.
ILL.
MO.
MINNEAPOLIS
ST. PAUL
DULUTH
ONTONAGON
MARQUETTE
GREEN BAY
MILWAUKEE
CHICAGO
DUBUQUE
LA CROSSE
ROCK ISLAND
DES MOINES
CEDAR RAPIDS
QUINCY
SPRINGFIELD
DECATUR
PEORIA
BLOOMINGTON
TERRE HAUTE
OSHKOSH
Sheboygan
Manitowoc
Racine
Kenosha
Waukegan
Madison
Janesville
Beloit
Freeport
Galena
Rockford
Elgin
Aurora
Joliet
Kankakee
Ottawa
Streator
Pontiac
Champaign
Danville
Havana
Lincoln
Mattoon
Effingham
Centralia
Vincennes
Lafayette
Kokomo
Peru
Logansport
Rochester
Austin
Albert Lea
Mankato
Fairbault
Owatonna
Winona
Red Wing
Hastings
Stillwater
Anoka
Princeton
Elk River
Little Falls
Brainerd
Crosby
Ironton
Aitkin
Virginia
Hibbing
Eveleth
Two Harbors
Superior
Ashland
Hurley
Iron River
Ironwood
Bessemer
Negaunee
Ishpeming
Marquette
Escanaba
Menominee
Marinette
Oconto
Peshtigo
Wausau
Stevens Point
Wisconsin Rapids
Merrill
Tomahawk
Rhinelander
Eagle River
Antigo
Shawano
Appleton
Fond du Lac
Watertown
Portage
Baraboo
Reedsburg
Wisconsin Dells
Tomah
Sparta
Black River Falls
Eau Claire
Menomonie
Chippewa Falls
Rice Lake
Hayward
Spooner
Grantsburg
St. Croix Falls
Osceola
Hudson
River Falls
New Richmond
Amery
Ladysmith
Park Falls
Phillips
Medford
Wausau
Monica P.
Rib Mountain
Weston
Abbotsford
Colby
Marshfield
Neillsville
Whitehall
Arcadia
Blair
Galesville
Independence
Winona
Lake City
Red Wing
Hastings
Farmington
Northfield
Faribault
Owatonna
Waseca
Mankato
St. Peter
Glencoe
Hutchinson
Litchfield
Willmar
Montevideo
Granite Falls
Redwood Falls
Marshall
Tracy
Slayton
Worthington
Luverne
Pipestone
Edgerton
Ellsworth
Sioux Falls Jct.
Canton
Elk Point
Vermillion
Yankton
Tyndall
Scotland
Parkston
Mitchell
Huron
Redfield
Aberdeen
Watertown
Sisseton
Wahpeton
Breckenridge
Fergus Falls
Detroit
Wadena
Staples
Brainerd
Baxter
Pequot
Cass Lake
Bemidji
Grand Rapids
Nashwauk
Coleraine
Grand Marais
Silver Bay
Two Rivers
Manitowoc
Sheboygan
Port Washington
Waukesha
Racine
Kenosha
Waukegan
Elgin
Aurora
Joliet
Kankakee
Ottawa
Streator
Pontiac
Champaign
Danville
Havana
Lincoln
Mattoon
Effingham
Centralia
Vincennes
Lafayette
Kokomo
Peru
Logansport
Rochester
Austin
Albert Lea
Mankato
Fairbault
Owatonna
Winona
Red Wing
Hastings
Stillwater
Anoka
Princeton
Elk River
Little Falls
Brainerd
Crosby
Ironton
Aitkin
Virginia
Hibbing
Eveleth
Two Harbors
Superior
Ashland
Hurley
Iron River
Ironwood
Bessemer
Negaunee
Ishpeming
Marquette
Escanaba
Menominee
Marinette
Oconto
Peshtigo
Wausau
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Redfield
Aberdeen
Watertown
Sisseton
Wahpeton
Breckenridge
Fergus Falls
Detroit
Wadena
Staples
Brainerd
Baxter
Pequot
Cass Lake
Bemidji
Grand Rapids
Nashwauk
Coleraine
Grand Marais
Silver Bay

rors of such a journey in an Arctic night, in continuous cold, without room for exercise or chance for securing warmth or preparing proper food. The survival of any one from such a drift, by boat or on an ice floe, would be simply miraculous. We cannot help admiring the calm courage and the self-sacrificing spirit that would tempt explorers to venture upon such a desperate undertaking under any conditions; but we feel that of all desperate enterprises proposed by man this one of Dr. NANSEN'S has the fewest chances for a favorable result and a safe return.

THE improvement of the Potomac River front of Washington, D. C., moves slowly, and Col. PETER HAIN, the engineer officer in charge, again calls attention in his last report to the wasteful Government policy of leaving this important work drag on with insufficient or no appropriations at all. Up to June 30, 1891, the sum of $1,626,821 had been expended, and $881,365 is needed to complete it, while only $13,294 remains on hand for the present year. The lack of funds has retarded the execution to such an extent that work already done has been damaged by freshets to a very considerable extent, and to repair this damage will require the expenditure of further sums not contemplated in the original estimates. The annual cost of preserving and maintaining this unfinished work is $5,000, the interest on $100,000 at 5%., or about one-eighth of the total sum required to finish this improvement. It is little wonder that Col. HAIN remarks that: "From a business point of view it would be an economical measure to appropriate in one sum the full amount needed." Long Bridge, at Washington, is another example of this dilatory government action. Projects for its removal or rebuilding have been urgently recommended by the engineer officers for years past. Its old-fashioned, clumsy piers are oblique to the axis of the river and its floods, and so surrounded by piles of riprap that they reduce the waterway of the Potomac fully 30 per cent. at that point. This bridge is a constant menace to the river front above it and to the government work on the flats below, upon which so much money has already been expended. Col. HAIN warns the War Department again that with a freshet occurring with a river full of ice, by no means an unlikely event, the most serious results are to be apprehended in the flooding of property and damage to executed works.

This policy of delay is an old complaint, and in the persistence in an attempt to spread a fixed sum of money over too many points of application, public works will continue to be delayed and public money will continue to be wasted. That more of it is not wasted now is due solely to the conscientious manner in which these works are conducted by the United States engineers. It seems to be impossible to impress the average Congressman with the necessity for providing for these works as he would for his own business at home, and to convince him that it would usually be better to do nothing at all until the necessary money had accumulated rather than to start a work that is to drag over years of unnecessary time and to cost many unnecessary dollars in interest and maintenance account. There is certainly nothing gained in time by the present methods, and it is as certain that much money is lost, or rather wasted. But if so flagrant an example can exist at the seat of government, where the law-makers can study for themselves the fine proportions of their practice, there is practically little hope for improvement in the appropriations for remote public works. The trouble is that every Congressman has his own district to serve in this respect, and while he would willingly take his loaf in one instalment, he is satisfied with any slice thereof that will persuade his constituents that he is doing "something" for them. This particular tendency explains the slowness of Congress to approve bills already presented to them which make it an essential preliminary to all public work that the amount needed to complete this work must be appropriated in bulk and made available as needed in the active conduct of affairs. Under such a law the first aggregate appropriation would probably be of enormous proportions, otherwise there would not be enough to go round among anxious Congressmen; but the annual expenditure of capital, when applied to the completion of improvements actually needed and approved by a board of engineers, would in the end certainly be no greater than that called for by present wasteful methods.

Railway Construction in the Northwest.

We present with this issue our annual map and statistics showing the progress of railway construction in the Northwestern States. The general reaction which followed the heavy construction of 1887 has perhaps been more noticeable in the states covered by our map than in any other section of the country. This, with the financial stringency of the present year, has given the impression that construction has nearly ceased. That this idea is not correct is seen by the table which is given herewith, showing by states the mileage in the various stages of progress. Nevertheless construction has largely decreased. The influences which have acted to bring this result about have been various, but all have tended to make the investing public cautious and to bring about a movement among capitalists to protect investments already made. That there is a tendency to be a little too cautious just at present is possible, but this is a good fault. Too many railways have already been built in this section which ought never to have been built, and a general weeding out of wild cat enterprises will be a benefit both to existing railways and to the country which they serve.

It also remains true, however, that our figures cover a large territory still unprovided with railway lines and which will for many years afford opportunities for the profitable investment of capital in railway construction. That these opportunities will be taken advantage of as soon as the prospects for a paying business will justify it is shown by our map and figures. A conservative policy will, however, be followed in this work, and it is probable that the Northwest will never again see a great rush of competitive construction such as signalized the year of 1887.

The following table gives by states the mileage in the various stages of construction:

States.	Track laid.		Under contract or construction.	Located and under survey.	Projects of some promise.
	1890.	To date in 1891.			
Ill.....	103.	13.1	276	318	455
Wis.....	636.6	55.5	136	397	1,055
Minn....	92.6	57.62	56	57	535
N. Dak...	38.	....	241	20	20
S. Dak...	128.7	57.4	148	562	381
Neb.....	274.	25.	...	202	...
Iowa.....	1.28	21.7	...	120	60
Man.....	370.3	104.	160	253	100
Total...	1634.5	322.3	1,017	1,929	2,606

Comparing these totals with those published in connection with our last preceding map of this section we have the following results at the dates named:

	Track laid. Year previous.	Track laid. Portion of year to date.	Under construction.	Under survey.	Projected.
Aug. 2, 1890.....	1,011	332	1,439	2,196	4,854
Aug. 1, 1891.....	1,634	322	1,017	1,929	2,606
Inc. or dec., 1891.....	+ 623	— 30	— 422	— 267	— 2,248
Inc. or dec. per cent.....	+ 61.6	— 8.5	— 29.3	— 12.2	— 46.3

From this it appears that there has been a considerable decrease both in the mileage under construction and the track built this year, and in the mileage surveyed and projected for future construction. The work needs, however, to be studied in detail before correct conclusions can be drawn. With one or two exceptions all the large systems are holding aloof from any extensive new construction, and have contented themselves with completing such lines as were well under way last year. The greater part of the track laid this year has been upon lines of this character, the work of construction being mostly done last year, and it is misleading, therefore, to take the total, which is but little smaller than that of 1890, as indicative of a probably equal mileage of track to be laid during 1891. About two-thirds of the mileage under construction is included in Illinois and the two Dakotas, and is nearly all being built by three or four companies. Of the total 800 miles included under this head in these three states and the State of Wisconsin, active work is in progress on only about 400 miles. The same is true to a less degree of the mileage under survey and projected. Most of the lines projected are in an embryonic condition, and the usual answer elicited by our correspondence with their promoters has been, "No immediate prospect of construction." Only in one case have we received an answer worthy of the genus "promoter," and this stated that "no surveys have been made and no termini decided upon," but concluded with the statement, "It is a sure go."

Of course this is largely due to the tightness of money, which affects new enterprises much more than it does those of old and well-established companies; but there are many other causes. Decreasing dividends, hostile state legislation, over-construction, rate wars, the tendency toward consolidation, and last, but by no means least, the increased knowledge of the investor have each played their part. There are indications that some of the most flagrant evils are being done away with, but many vexed questions are yet to be settled before it can be prophesied what work will be undertaken.

It will be noticed that the centers of greatest activity have changed but little. The large increase in the mileage under construction in the Dakotas is due to increased activity upon a few lines which have been under way for several years. The character of the lines under construction also remains the same. Nearly all are being built to furnish connections between existing roads or to develop local traffic.

Considering the work by states, it is seen that Wisconsin and Illinois have a large mileage under way. The construction in the latter state is confined to the southern portion, outside of the limits of the map, and will be discussed in connection with our map of the Southwestern States. In Wisconsin the work consists largely of short branches into the lumber regions. The most noticeable of the surveyed lines is the Wisconsin Midland, which has been on the carpet for some years. There is little prospect of much work being done for some time. The Eau Claire, Mississippi & Lake Superior and the Wisconsin Bee Line & West Superior companies have lines projected through the timber lands from Winona, Minn., to Ashland, 200 miles, and from Milwaukee to West Superior, 360 miles. No work is likely to be done upon either this season. Farther north in the western Peninsula of Michigan the Chicago & Northwestern has completed a short line this season and the Duluth, South Shore & Atlantic has surveyed a 55 mile branch to connect with the lake steamer lines at Escanaba. The Escanaba, Iron Mt. & Western R. R., which completed 53 miles last year, has been sold, together with the Chapin mines, and will be operated in harmony with the Chicago & Northwestern R. R., which it was built to compete with.

Active construction in Minnesota is confined to three lines. Of these the Winona & Southwestern and the Duluth & Winnipeg are old acquaintances,

and each has done considerable work this year. The latter, which is projected to run from Duluth to Winnipeg, Manitoba, penetrating the timber and grain regions of Minnesota and Manitoba, has completed 81 miles and is now at work on an extension into Duluth. The attempt to obtain a land grant from the State of Minnesota, and the negotiations necessary to secure the right of way through the Indian reservation, have delayed the construction of the northern extension, but it is now stated that there will be no further delay. It is not quite clear, however, where the capital to build the line is coming from, and it is probable that the road, as a whole, will not be completed for some time. Farther west the Wadena & Park Rapids R. R. is being built north into the same territory, probably in the interest of the Great Northern Co., and is undoubtedly intended to connect with the extension from Crookston east and furnish that company a line through the wheat lands of Western Minnesota. The only other enterprise worthy of note is the Duluth, Red Lake Falls & Northern. This company has completed a rough preliminary survey for a line through the northern part of the state, but nothing further has been done, nor is there likely to be for some time.

In the Dakotas, construction is more active than it has been for some years before. The Minneapolis, St. Paul & Sault Ste. Marie has revived the long-projected line between Aberdeen, S. Dak., and Bismarck, N. Dak., and is working on a new line from Hankinson to Valley City. The most live enterprise is the Duluth, Pierre & Black Hills R. R. This company is independent at present, but the stock is owned largely by Northern Pacific stockholders, and it is probably intended to furnish that company a line into South Dakota, and ultimately farther west. The only other work under way is in the region tributary to the Black Hills, and is sufficiently described in our detailed list.

Very little work is in progress in Nebraska and Iowa. A small stretch of track has been laid in each state, but no construction is in progress, and there is very little life in the various surveyed and projected lines. The most noticeable feature of our map is the absence of the much-lauded Pacific Short Line, which was to be a competitor to the Union Pacific, and furnish some of the other great systems an outlet to the Pacific Coast. This company was placed in the hands of a receiver early in the present year, and is to be sold in foreclosure in a few weeks. There is some talk of a reorganization and further construction after the sale, but it is doubtful if any work is done for some time yet.

The work in Manitoba is being done principally by the Canadian Pacific Ry., and consists of several extensions into the coal and wheat fields of Manitoba and Assiniboia.

Considering the work as a whole, it is probably as active as the condition of affairs will warrant. The people of this section have done much to frighten capital away from their territory, and may congratulate themselves that there is as much work in progress as there is.

CORRESPONDENCE.

The Aspen, Colo., Collision.

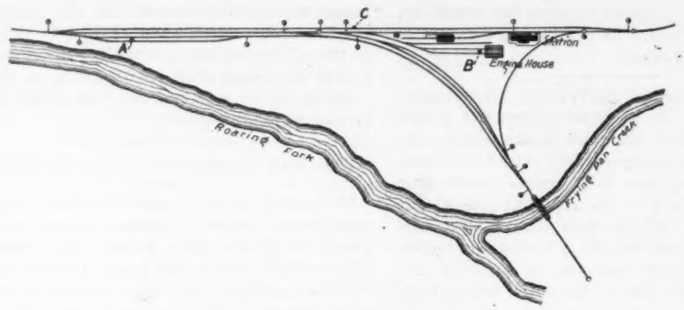
COLORADO SPRINGS, Colo., July 22, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I notice in the news columns of your issue of July 18 a reference to the unfortunate accident which happened on the Colorado Midland Ry. on July 12, at Aspen Junction, and also some editorial comment, and it occurred to me that you would perhaps be interested in the facts in regard to the accident. The accounts published in some of the papers here were a very fair statement of the facts, but in other cases they were highly sensational.

The train was an excursion train known as the "laundry train," that makes a trip every Saturday night from Aspen to Glenwood, to allow people to spend an hour in the famous swimming pool at that place. This "laundry train" was on its return from Glenwood to Aspen, and drew into Aspen Junction about 10 o'clock P. M.

I send you with this a blue print which shows the situation of Aspen Junction. The train on its arrival proceeded directly to the water tank to take water. There was a freight train made up and standing on the side track at A, ready to proceed westward on the arrival of the "laundry train." The engine was standing at B, waiting for the train crew to put it onto the west-bound train. On the arrival of the "laundry train," the conductor went to the engine and asked the engineer if he



PLAN OF ASPEN JUNCTION, COLORADO MIDLAND RY.

was ready to go; he replied that he was. The brakeman took the blocks out from under the engine wheels and started a short distance ahead of the engine to go to the switch at C to let the engine out onto the main line, the engine following him, with the engineer, fireman and conductor on board. The engine was moving very slowly, not faster than the brakeman could walk. When the brakeman stepped onto the main line at the frog, he glanced up the track and saw the "laundry train" backing down toward him. He immediately signaled for the train and the light engine to stop, but neither stopped in time to avoid a slight glancing blow, the side of the coach rubbing along the running board on the side of the engine. The blow was not sufficient to seriously injure either coach or engine, but one of the window casings in the coach struck the check-valve on the side of the boiler, breaking it off. This left a 2-in. orifice in the boiler, through which a jet of steam and water was forced by the steam pressure on the boiler, which was at first about 150 lbs. This jet of steam and water struck one of the windows in the coach, which, of course, broke on the first contact, and that part of the coach was filled with steam.

It was not a pleasant night, and only a few people made the trip to Glenwood, and the train contained but one coach, which was divided by a partition into two compartments, the compartment in the front end of the coach being a smoking-room, and the rear compartment being the first class part of the train and devoted to the use of the ladies and their escorts. There were two passengers on the front platform of the coach and two in the smoking compartment. These four escaped without injury. In the rear compartment there were four gentlemen, eight ladies, and a child 18 months old; all these were severely scalded by the steam and hot water; two of them, the 18-months-old child and a young lady 18 years old, were taken out of the car dead; eight died later on, leaving three now living.

The Transportation Department has not completed the investigation of the accident, and is not yet prepared to make any comments in regard to the responsibility. The coroner's jury found that the brakeman and conductor of the freight crew were guilty of gross negligence. X.

St. Paul, Minn., and Census Bulletin 82.

ST. PAUL, Minn., July 21, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your extracts from Census Bulletin No. 82, in the NEWS of the 4th inst., the city of St. Paul is, by an error of the census officials, made to appear as expending the largest amount per capita of any city in the United States in the conduct of its administrative affairs.

In order to correct this and give the correct information I send you a certified report of the financial expenses of St. Paul for the year 1889, from which you will see that the city expended $4,048,883 in the construction of public improvements (*new* bridges, sewers, water-works, paving, grading, etc.), all of which in the census bulletin is classified as "administrative." From the same report it appears that the amount properly charged to administrative or running expenses was, as a matter of fact, $1,971,040. From this the per-capita expense becomes $14.80. As you will readily see, the expenses of the permanent public improvements cannot, with justice, be charged to "running expenses," and it is but right that the city should be credited for the public spirit shown in these improvements rather than classed as one with an extravagant administration. Respectfully yours,

GEO. L. WILSON, Asst. City Engineer.

[Judging from the discrepancies pointed out for the cities of New York, Brooklyn and now St. Paul the "administrative" expenses of our American cities as given in Census Bulletin No. 82 have not been carefully deduced, in all cases, at least. The intricacies of some of these accounts and the difficulty of subdividing them by any party not thoroughly familiar with all the details is evident. But in all doubtful cases the city affected should have the benefit of the doubt and receive credit, as Mr. WILSON says, for public spirit shown in public improvements. We make the correction for St. Paul with pleasure, and will do the same for other cities pointing out material error in the same direction. ED. ENG. NEWS.]

Concerning So-Called "Engineers."

NEW YORK, July 20, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I beg for a small space in the NEWS to bring to the attention of engineers a complaint which I have often heard in private but do not recollect seeing in print.

It is simply this: Is there no way of protecting the public against so-called engineers who simply assume this title to make a little money, and who have neither brains nor ability to become even a country surveyor, and who cast discredit on the work of others? Is there no redress to be obtained from them for work they undertake, and which they are utterly incompetent to do? Is there no punishment for accepting money to do work which has to be done over again on account of their gross ignorance and carelessness combined?

Physicians and lawyers cannot practice until they give some proof of their knowledge of the profession which they propose to adopt: why should we be less careful regarding the candidates for our profession? It seems to me that the engineering societies might, in the absence of law, take such action in the matter as would to a large extent do away with these "shysters" in the profession.

Suppose, to state it in the rough, that the members of the American Society of Civil Engineers should agree not to employ any engineer on work under their charge unless he was connected with that society or another whose standard of admission was sufficiently high. This would necessitate joining one of the societies by every one who expected to practice civil engineering. Should one then prove unworthy he could be expelled and I think would not be likely to force himself on the public again as an engineer.

It does not seem to me that the scheme outlined is impracticable. It may be objected by some that it is not feasible because there are so many engineers who are at present non-members of any society. But this objection will soon remedy itself. They will come into the fold fast enough when they find there is anything to be gained by doing it or lost by not doing it.

The remedy would not effect a cure at once; it will take time and it ought to be re-enforced by stringent laws on the subject. The non-professional public are not the only sufferers. Engineers themselves are often the victims of these pretentious scallawags as I and others known to me have found by bitter experience, and when found out they are simply discharged and we have to "grin and bear it."

There is scarcely one of us, probably, who cannot point out public work which shows the effect of their prentice hand. I would like at least to hear the opinions of engineers upon this subject, which affects us all.

M. AM. SOC. C. E.

[One serious objection to the above scheme is that in perhaps the majority of less important railways

and in many municipalities the engineer is appointed by members of a board of directors, or of a city council, who are not and cannot be engineers themselves. The Member of the Am. Soc. C. E. usually selects the best engineer he can find, for his own safety and comfort, and it is not with their men that the trouble lies. The suggested remedy would not meet the other case.—ED. ENG. NEWS.]

The Hastings Tower for the World's Fair.

KANSAS CITY, Mo., June 25, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Some time since the following appeared in your paper: "An Eiffel tower upside down is the somewhat startling novelty offered to the World's Fair Commissioners by a Kansas City engineer, Mr. Hastings . . . We are inclined to agree with the Kansas City *Times* in the belief that if anything went wrong with the guys, 'it would not take more than three agitations of the atmosphere before there would be old iron for sale.'"

I think that the paragraph does me some injustice, and I would like to submit some figures showing that the proposition is not altogether absurd.

In the calculations for the stability of the tower, it is assumed that the cylindrical portions will produce one-half and the open portions one-third of the wind pressure, which would result from a vertical solid plane surface of exual area of outline. It is assumed that the pressure is divided equally between the two superposed cables, and that under the extraordinary circumstances of maximum pressure the cables can take 50,000 lbs. per sq. in. of section, which is perhaps no more than is sometimes taken by the cables of the New York and Brooklyn Bridge.

The weight of the cables is supposed to be concentrated at the intersection of the tangents drawn from the ends of the arc, and the directions of the forces at the ends of the cables will be parallel to the e tangents. The cable is su posed to hang in the arc of a circle, and the length of the chord will be the square root of the sum of the squares of the vertical and horizontal distances between the ends of the cable.

The wind pressure is taken at 57.1 lbs. per sq. ft. of vertical plane surface, making the total pressure 1,060,000 lbs., or 530,000 lbs. for each pair of opposite cables. This force must be met by the difference of the horizontal components of the strains in these two opposing cables.

In the illustration one half of the tower is shown and one of the cables; there is supposed to be another below the one shown. The length of the arc is 1,237.6 ft., and the vertical distance between the top and bottom of the cable is 720 ft., and will be considered as remaining constant; the weight of the cable is supposed to be concentrated at the point W.

In the force triangle at the left, the lines $A\,B$ and $A\,C$ are drawn parallel to the tangents at the ends of the arc, and the line $A\,F$ is parallel to the chord. The angle $C\,F\,A$ is equal to the angle $L\,N\,M$. The horizontal component of the strain in the cable will be the altitude $E\,A$ of the force triangle $A\,B\,C$, in which the strains at the ends of the cable and the weight of the cable itself are the component elements. The line $A\,F$ parallel to the chord will bisect the angle A. A rule on page 17 of Trautwine gives:

$$\text{length of arc} = \frac{\text{chord of } \tfrac{1}{2} \text{ arc} \times 8 - \text{chord}}{3};$$

or:

$$\text{chord of } \tfrac{1}{2} \text{ arc} = \frac{\text{arc} \times 3 + \text{chord}}{8}.$$

This formula is so close for the small arcs considered as to need no correction. The angle between the chord of the arc and the chord of the half-arc is one-half the angle between the chord of the arc and the tangent; so if A is the angle between the tangents at the ends of the arc:

$$\cos \tfrac{1}{4} A = \frac{\text{chord of } \tfrac{1}{2} \text{ arc}}{\text{chord of } \tfrac{1}{4} \text{ arc}}.$$

Substituting above value of the chord of ½ arc,

$$\cos \tfrac{1}{4} A = \frac{\text{chord} \times 4}{\text{arc} \times 3 + \text{chord}}.$$

But chord equals $\sqrt{(LM)^2 + 720^2}$, and arc equals 1,237.6; so.:

$$\cos \tfrac{1}{4} A = \frac{4\sqrt{(L\,M)^2 + 720^2}}{\sqrt{(L\,M)^2 + 720^2} + 3712.8}.$$

$$\sin CFA = \frac{L\,M}{\sqrt{(L\,M)^2 + 720^2}}.$$

In the force triangle $A\,B\,C$, the supplement of the angle C is $C\,F\,A + \tfrac{1}{2} A$, and in that triangle, therefore:

$$A\,B = \frac{C\,B \times \sin (C\,F\,A + \tfrac{1}{2} A)}{\sin A}.$$

In the triangle $A\,B\,E$, the angle B is $C\,F\,A - \tfrac{1}{2} A$ and, $EA = A\,B \times \sin (C\,F\,A - \tfrac{1}{2} A)$

$C\,B$ represents the weight of the cable, and $E\,A$ is the horcomponent of the strain in it. Combining the above equations and making $C\,B$ equal to unity:

$$E\,A = \frac{\sin (C\,F\,A + \tfrac{1}{2} A) \sin (C\,F\,A - \tfrac{1}{2} A)}{\sin A}$$

If $L\,M$ equals 1,004.5 when the tower is vertical, and if 0.9 ft. is the amount of motion from the vertical to the point of the equilibrium where the difference of the horizontal components of the strains in the opposing cables equals the wind pressure, the value of LM will change from 1,004.5 to 1,003.6 and 1,005.4 for the two opposing cables. If the cabl has a metallic section of 71.89 sq. ins. it will weigh 302,750 lbs. at 490 lbs. per cu. ft., and will be about 10 ins. in diameter, which is about that of the cables at the Niagara Suspension Bridge. The horizontal components per lb. wt. will be 4.7893 and 3.0037; their difference is 1.7766, and the total difference for the two cables will be:

$$302{,}750 \times 1.7766 = 537860,$$

or 7,860 lbs. more than the wind pressure.

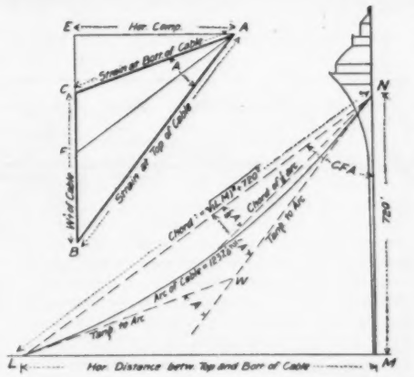
The dynamic strains have not been considered, and they will be quite large. It will be assumed that the tower is pushed by a wind of 57.1 lbs. pressure to the point of equilibrium, and that the direction of this wind is suddenly altered by 180°, throwing the entire pressure on what was the leeward side of the tower. The tower will move to the poin' of equilibrium on the opposite side and pass beyond it. The distance between the points of equilibrium is 1.8 ft., and, as will be seen subsequently, the tower will move 1.774 ft. farther under the momentum.

The ft.=lbs of energy in the momentum of the tower, to be overcome by the two opposite cables will be:

$$530.00 \times (1.8 + 1.774) = 189420.$$

The work done by the cables as the tower moves between the points of equilibrium results in nothing. All these ft.-lbs. must be counteracted by the cables after the tower has passed beyond. The ft.-lbs. of energy arising from the cables and counteracting those in the momentum of the tower will be the mean of the differences of the horizontal components of the strains in the cables as the tower moves from the point of equilibrium to the limit of motion, multiplied by the distance from the point of equilibrium to the limit of motion.

A portion of the motion of the tower will produce motion of the cable, and a portion will produce stretch of the cable. As will be seen, 0.9 of the motion of the tower beyond the point of equilibrium will produce motion of the cable, and the remainder, 0.874, will produce stretch of the cable. This being the case, the horizontal component of the strain in the cable at the limit of motion will be almost exactly the same as it would be at a point 0.874 ft. inside that limit, if there were no stretch. The following table shows the conditions during the motion of the tower beyond the point of equilibrium, each 0.2 of motion producing nearly the same movement of the cable



as 0.1 would produce if there were no stretch. It is assumed that the contraction of the leeward cabled is the same and will produce the same effects as the stretch on the windward one, though this is by no means true. The results are calculated from the preceding formulæ for each 1 lb. weight of the cable:

Leeward cable.		Windward cable.		Difference of hor. comps.	Avg. of diff. of hor. comps. during each tenth motion
L. M.	Hor. comp.	L. M.	Hor. comp.		
1003.6	3.0037	1005.4	4.7803	1.7766	1 9177
1003.5	2 9878	1005.5	5.0167	2.0589	2.1925
1003.4	2.9004	1005.6	5.2266	2.3262	2.4813
1003 3	2.8574	1005.7	5.4907	2.6423	2.8331
1003.2	2.8084	1005.8	5 8323	3 0239	3.2637
1003.1	2.7727	1005.9	6.2762	3.5035	3.7679
1003.0	2.7332	1006.0	6.7655	4.0323	4.3681
1002.9	2.6970	1006.1	7.4009	4.7039	5.1554
1002.8	2.6596	1006.2	8.2663	5.6069	6.2342
1002.7	2.6292	1006.3	9.4906	6.8614	

9) 32.2169

Avg. of diff. of hor. comps throughout motion = 3.5797

The ft.-lbs. of energy arising from the cables will then be: 3.5797 × 1.774 × 302,750 = 1,922,600, or 28,400 more than there will be in the momentum of the tower.

The stretch of the windward cable will be due to the difference of the average strains throughout the cable taken first at the point of equilibrium and then at the limit of motion; the average strain being the average of the strains at the top and at the bottom of the cable, and will be for each square inch of section:

$$\tfrac{1}{2}\left(\frac{\text{hor. comp.} \times \text{wt.}}{\sin (C\,F\,A + \tfrac{1}{2} A) \times \text{sec. area}} + \frac{\text{hor. comp.} \times \text{wt.}}{\sin (C\,F\,A - \tfrac{1}{2} A) \times \text{sec. area}}\right).$$

The average strain throughout the windward cable at the limit of motion will be 49,205 lbs. per sq. in., and at the point of equilibrium will be 24,868, a difference of 24,337. The motion of the tower due to the stretch will therefore be:

$$\frac{24337 \times 1237.6 \times \sin C\,F\,A}{28000000} = 0.874 \text{ ft.}$$

$C\,F\,A$ is taken at 54° 22'. It varies but six minutes in any case, and 28,000,000 is the modulus of elasticity. The maximum strain in any cable will be that at the top of the windward cable at the limit of motion, and will be 50,131 lbs. per sq. in.

The contraction of the leeward cable will be quite small, as the strain per sq. in. only varies about 2,000 lbs. while the tower moves from the point of equilibrium to the limit of motion. The motion of the tower, therefore, produces motion of this cable, and not stretch, which reduces the horizontal components of its strains more rapidly than the table indicates, tending still further to check the motion of the tower. The motion of the top of the tower is taken up by the elasticity of the metal at the bottom, and, if that metal can be safely sprung one-one-thousandth of its dimensions without injury, it will be seen that all the motion of the top will be taken up at the bottom in a distance of not to exceed 100 ft. from the base.

With a wind of 50 miles per hour, or 12.5 lbs per sq. ft., such as only occurs in this latitude at the surface of the ground 2 or 3 times a year, the point of equilibrium will be less than 3 ins. from the vertical; so it seems as if the tower might be called a very stiff structure.

As an excuse for proposing the erection of this structure, I will say that, for the same height and approximately the same area of outline, a tower built on this principle will weigh about two-thirds as much as the Eiffel, and I think I see ways in which all evident difficulties, such as the erection, the elevator service, securing right of way for the cables, etc., might be overcome. An absolutely accurate determination of the strains in the cables would require the use of higher mathematics than I am capable of handling, and would probably not be understood by most readers. Respectfully,

CHAS. W. HASTINGS.

[We did not intend to do the projector an injustice, but admit that we were struck with the aptness of the criticism of the Kansas paper quoted, and used it as above. We see nothing impossible in the suggestion of Mr. HASTINGS, and his plan certainly has the merit of startling novelty, which seems to be the feature many people connected with the Exhibition of 1892 are in search of. But while his calculations are interesting, and we give them in full, there are other points to be considered. As near as we can figure it, the load on the base of the tower would be about 9 tons per sq. ft., and, while this might be provided for, it would be troublesome and expensive on Chicago soil. The anchorages are also details of importance. But if Chicago wants a novelty, and sees fit to spend the money on it, this scheme is better than many of those already proposed; though we must honestly confess we would rather not lurch about in its top restaurant during a high wind.—ED. ENG. NEWS.]

The Expedition of Dr. Nansen to the North Pole.

In the last number of *The Forum* Dr. FRIDTJOF NANSEN, who was the first Arctic explorer to cross Greenland, and is himself about to start out for the Pole on an original route, gives the theories which have induced him to attempt to drift in that direction. Dr. NANSEN starts out with the statement that all previous expeditions using ships have been finally stopped by the impenetrable drifting floe ice coming from the unknown North. But it is a simple and valid conclusion that as these currents come from the north other and counter-currents coming from the south must somewhere exist. The question is to locate them and then to follow where they may lead. This, in brief, is Dr. NANSEN'S plan.

In attempting to define the point where this polar current trends northward he first points out that the most important current pointing southward passes down the east coast of Greenland, where the open sea is widest between that coast and Norway. This current fills nearly the whole space between Greenland and Spitzbergen, with a width of about 250 nautical miles, and over the greatest known depths of the arctic seas, or 2,600 fathoms. The current itself, the author believes, does not extend deeper than 200 fathoms and has an average speed of 2 nautical miles per day. From these data we can assume that this current carries southward, in every 24 hours, the enormous mass of somewhere between 80 and 120 cubic miles of water. This water must come from somewhere, for the Greenland current acts like a pump in sucking water from the whole Polar Sea.

The only known currents running in to this sea are: The small branch of the Gulf Stream passing up the west coast of Spitzbergen, which is supposed to turn and come back on the other side of this same island; another branch of the Gulf Stream hugging the coasts of Norway and Nova Zembla, and the most important current of all, the one entering the Bering Strait from the south. Professor MOHN believes that the second-named current carries at least 60 to 70 cubic miles of water per day into the polar basin. The Bering Strait current has a velocity variously estimated at from 2 to 4 knots, and it carries enormous quantities of driftwood. Taking the strait as being 49.33 nautical miles wide and as having an average depth of 23.5 fathoms, an average speed of only half a knot would pass about 14 cubic miles of water daily.

Dr. NANSEN points out that the drainage of the great rivers of Siberia, British America and Alaska into the northern sea, while comparatively small in amount, has another important bearing on this problem. He figures that the whole quantity of moisture falling over Siberia is only about 626 cubic miles per annum, and owing to evaporation it is probable that not more than one cubic mile per day

of this water reaches the sea. But this addition, small as it is, is fresh and comparatively warm water, is light and keeps on the surface a long time, and thus produces surface currents running northward from the Siberian coast, and also explains the reason for so much open water along this coast.

From this résumé of currents into and out of the Polar Sea Dr. NANSEN then deduces the point of northward trend. He finds the two chief inflowing currents the Nova Zembla and the Bering Strait currents, coming from different directions, and thinks that these two should meet about north of the mouth of the Lena River. This river carries a considerable body of comparatively warm water northward, and the probable track to join the Greenland current would lie close to the Pole itself, and between it and Spitzbergen. As direct evidence of this he gives the case of the *Jeannette*, that was caught in the ice on Sept. 16, 1879, north of Bering Strait, and drifted to the north and northwest until she was crushed in the ice and sunk on June 13, 1881, north of the New Siberian Islands. In this period she drifted from 71° N. 175° W. to 77.15° N. 155° E. As she approached the region where she was finally lost the current seemed to grow stronger, and in the last week she drifted with a speed of more than 8 miles in 24 hours. More remarkable still, in this respect, a number of objects belonging to the *Jeannette* and her crew were found on an ice floe near Julianshaab, on the southwest coast of Greenland, just 3 years after she sank, or June 18, 1884. Among these things were a list of provisions signed by DE LONG, a written list of boats of the *Jeannette* and a pair of oiled linen trousers marked "Louis Noros," the name of one of that ship's crew, and now surviving. These objects must have been left on the floe near where the *Jeannette* sank, or somewhere between that point and the mouth of the Lena River. From this region they could only have passed to the point where found by an east Greenland current, and the shortest and natural route would be across the Pole; had it gone by any other route, Dr. NANSEN shows that it must have encountered either contrary currents or warmer water.

As another proof, a harpoon throwing-stick of a peculiar shape was found several years ago on the west coast of Greenland, near Godnalb. When it came to the ethnological museum at Christiania it was found that it came from Alaska, in the region of Norton Sound; and it was further ornamented with Chinese glass beads, which are bought by the Alaskan Eskimos on the Asiatic side of Bering Strait. This throwing-stick, then, must have reached Greenland in the same way as the objects from the *Jeannette*.

As further proof he gives the fact that a considerable quantity of Siberian and American driftwood every year reaches the coast of Greenland; and this has been examined by Dr. NANSEN and does not appear to have been in the water for a very long time. Then, too, the thickness of the ice carried southward along the east coast of Greenland is proof that it must have floated for a long time in the sea. Along the Siberian coast and north of Bering Strait the ice is always comparatively thin (7 to 10 ft.); the ice floating past Greenland is from 40 to 50 ft. thick, or even thicker. This can only be accounted for by supposing that this ice is carried northward and grows thicker as it passes the Pole. Many specimens of pumice are found on the shores of Norway, Spitzbergen and Greenland, and BACKSTORM, a Swedish geologist, says that these consist of andesites, and must either come from unknown volcanoes in the polar regions, or from the great andesitic volcanic regions near Bering Strait.

For the reasons here given Dr. NANSEN feels fully entitled to conclude that a current is constantly running across the Pole in the direction named, and that the natural way to reach the Pole or a point near it is to enter this northbound current near the New Siberian Islands, and let it carry the ship across. This can be done in a strong ship, or by taking only boats along and encamping on the ice floes in the passage across. He proposes to utilize both these methods by building a small, strong ship of about 200 tons burden, capable of carrying provisions for 12 men for 5 years, and the necessary coal. He would have an engine capable of giving a speed of 6 knots, and have besides a full rig for sailing. The important point is to shape the hull of the ship so as to give the greatest resistance against crushing by ice. Her sides would slope from the bulwarks to the keel, so that a pressure will tend to lift her out of the water. The *Jeannette*, though very badly modeled in this respect, withstood the pressure of the ice for 2 years. This ship is commenced. It will be built of oak, with very thick sides, and strongly braced within, and with an extraordinarily strong bow. She will have two sheathings of oak plank and a third and outer one of hard oak or green heart, and may be plated with mild steel along the water line. Capt. OTTO SVERDRUP, who was with Dr. NANSEN in his trip across Greenland, will command the ship. It was intended that the start should be made in February, 1892, but they will hardly be ready by that time.

He will attempt to pass through Bering Strait in June, and then work his way to the New Siberian Islands, and pass as for north as possible in the open water of August or September. He will then run into the ice at the most favorable point—and drift, as he hopes. He expects that it will take him some years to reach the open Greenland water. If the ship should be crushed, he would move his provisions, coal, boats, etc., to an ice floe and encamp there; and for this purpose he takes, besides light boats, one large enough for all the men to sleep in. He thinks, from previous experience, that there is no great risk in this method; there is no surf, and the water is quiet. If his ship is stopped by unknown lands near the Pole he will abandon her and strike for the nearest current to drift on again. He also provides for returning homeward by way of the ice and Spitzbergen, or any other land where there is open water. The expense of this expedition is met by $55,000 granted by the Norwegian National Assembly and by $30,000 subscribed by the King and 12 private citizens.

The North Baltic Canal.

The North Baltic Canal between the harbor of Kiel and a point on the lower part of the Elbe River will be approximately 61 miles long when completed. About 4,000 men and from 30 to 40 dredges of various kinds are at work on the line, and it is hoped that the first ship will be able to pass from the Elbe to the Baltic some time in 1895. The most interesting parts of the work, according to the *Centralblatt der Bauverwaltung*, are the construction of sand walls through the marshes, the methods of protecting the banks and the bridge near Gruenenthal.

The marsh in some places is so soft that it resembles a soft pulp or jelly, and it was found that any trenches dug in the material were soon filled up by a slow flow of earth from the sides. In such cases a very light platform is built on rows of piles, and a track laid on it at a slight grade, to facilitate the handling of small cars containing a half a cubic yard each. The cars are loaded with sand and allowed to run down grade to the end of the line, where they discharge their contents about the piles, thus forming a stratum of material which gives the piles an increased bearing power. Two parallel embankments are built and when finished they form the banks of the canal.

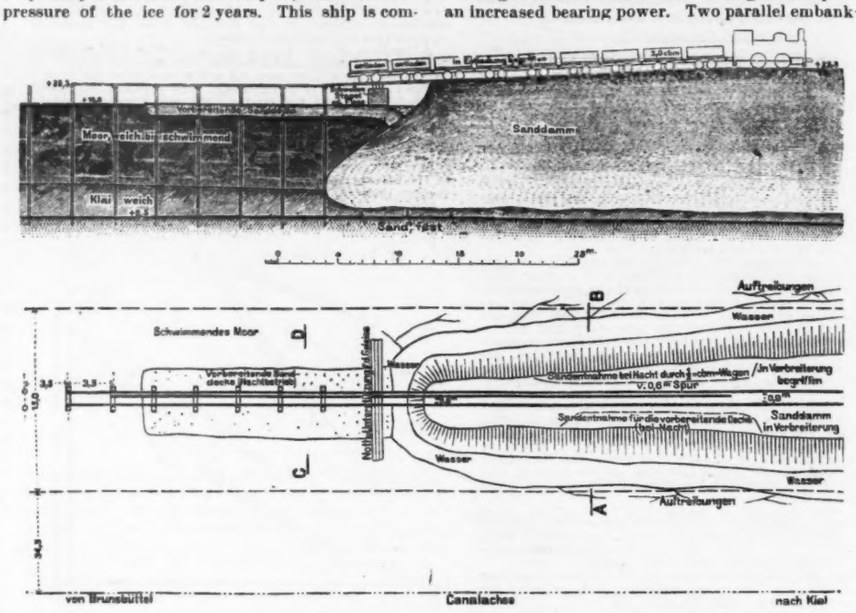


Fig. 1.—Method of Constructing Sand Embankments Through Marshes. Dimensions in Meters.

The material used was taken during the night from the sides of the walls already formed. On the somewhat insecure track thus constructed side tip-cars of 3 yds. capacity were slowly run forward. The first car was emptied, then the train run forward a car length and a second car emptied, and so on. In this way the platform was subjected to the least possible weight and the material was deposited at the most advantageous point. In this semi-liquid marsh the head slope of the sand wall had the same general shape as an ordinary sand pile, only slightly more upright on account of the pressure of the surrounding earth. The lateral section of the wall was trapezoidal. At first there was a depression around the wall in which water collected, but later on the surrounding earth rose in places as high as the top of the embankment. The earth thus driven up was gradually dried, and at length sank back to its original position.

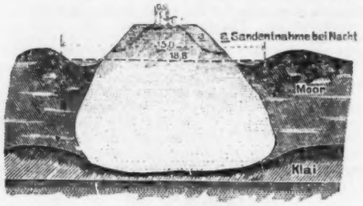


Fig. 2 Section on A B, Fig. 1.

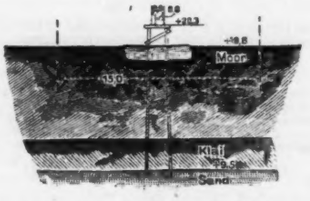


Fig. 3. Section on C D, Fig. 1.

Dimensions in Meters.

The shape of the embankment was ascertained by borings, and the sand was piled up until the bottom rested on firm strata of clay or sand. The width of

the embankments were such that the canal could be given a proper section between them.

Where the marsh is not so insecure the piling is omitted. The top of the ground is then excavated to a depth of about 2 ft., and a trench about 40 ft. wide thus formed. In this trench the sand is dumped. The longitudinal section of the head of

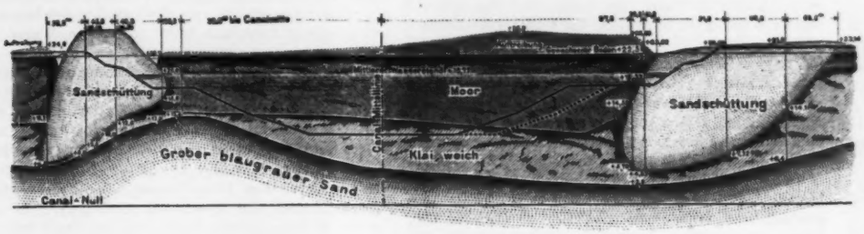


Fig. 4.—Cross Section of Diluvial Marsh and Sand Embankments Before Excavating. The Heavy Line Gives the Cross Section of the Finished Canal. Dimensions in Meters.

the embankment is totally different in firm ground from the shape assumed when the marsh is very insecure. The sand slopes back and down from the head and lies over in place of flowing under the marsh. The lateral sections, moreover, have approximately vertical sides, or are pear-shaped.

Wherever this work was carried on in the region of alluvial deposits, the firm stratum upon which

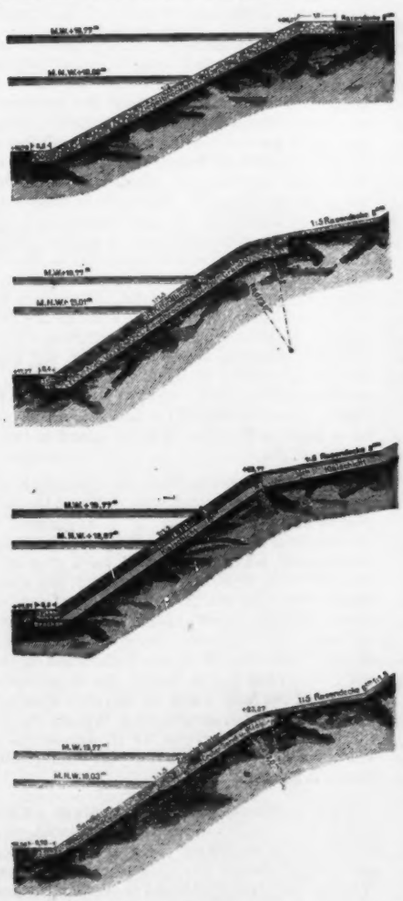


Fig. 5.—Different Methods of Facing Slopes of Canal.

the embankment rests was found to be practically level. But when the excavation was begun in the diluvium between Rendsburg and Holtenau, where this position of the strata no longer obtains, it was found that there was often no suitable foundation for the embankment on account of the folding of the strata. In the depressions water had collected, and the marshy structure extends to a considerable depth. The nature of the ground and the disposition of the strata were determined in the most difficult points by borings and soundings. In this way it was possible to regulate to some extent the amount of material dumped at the several points in order to obtain the best results.

The cross-section of the canal has in its upper part about 6½ ft. below the mean-water level, a berm from 8 to 30 ft. wide, according to the nature of the ground. This berm serves to support the foot of the stone facing which protects the banks from waves.

The facing was at first designed with a single slope in order to economize in excavation. Soon after the beginning of the work this plan was found to be impracticable, owing to the impossibility of laying the covering quickly enoughto preserve the slope from the destructive effects of the weather. Slips occurred in several places, and the fear that others would also happen led to the adoption of a smaller berm half way between the first and the top, by which means the facing could be laid in two parts without difficulty.

The material used was of several kinds, and laid in different methods according to its position above or below water and the class of stone at hand. Where dry land was traversed the contractors were required to use glacial boulders from the cuts. Where these could not be obtained and broken stone was too expensive, clinkers or partly vitrified brick were employed. In some places concrete was also used below the water. These materials were laid in the four following methods:

1. Below the water level a layer of broken bricks or stone is laid to a depth of 12 ins., the finer material being below and the coarser on the surface. When rocks can be obtained, they are also employed after being broken up into angular pieces. If left in the rounded state in which they are found, the waves from passing vessels would tend to loosen them and thus diminish the stability of the facing. At the bottom of the slope is a foot of brick about 1½ ft. wide and 12 ins. thick.

2. Where small boulders and broken stone are used, a bed of broken brick or fine gravel is laid to a depth of 8 ins. and then covered with a pavement of stone 12 ins. thick, which joins the turf-covered top by a curve of about 10 ft. radius.

3. Where the natural material of the ground is fine sand, this is covered with an 8-in. layer of clay and then paved with a 10 in. layer of brick, resting on a foot of broken brick 1½ ft. wide. The curve at the top has a radius of 3¼ ft. in this case.

4. Where stone and brick are expensive, while sand and cement are cheap, a footing of broken stone 2½ ft. wide and 10 ins. thick is prepared, and the facing laid in three sections. The lower section, lying below mean low water, has a 2-in. bed of sand covered by 8 ins. of strong cement, made in the proportion of 1:6. Above this comes a layer of clinkers 10 ins. thick resting on 4 ins. of sand, and above this a layer of brick on a layer of sand 12 ins. thick, ending in a curve of 6½ ft. radius.

To carry the track of the West Holstein Ry. and two highways over the canal at Gruenenthal, an arch bridge is now being built. It has a span of 513 ft. between supports, and its height at the crown is 138 ft. above high water, sufficient to permit the passage of the largest ships by lowering the topmasts. The form of the bridge was due to the uncertainty concerning the foundations if piers were sunk in the canal proper.

The railway line, which is single track, is laid in the middle of the bridge, and since the clear width between the trusses is only a trifle over 21 ft. it will be impossible for carriages and trains to cross simultaneously. For about 330 ft. in the center of the bridge, the roadway is separated from the foot walks, which are 5 ft. wide, by the suspenders from the trusses. At the ends of the bridge the carriage-

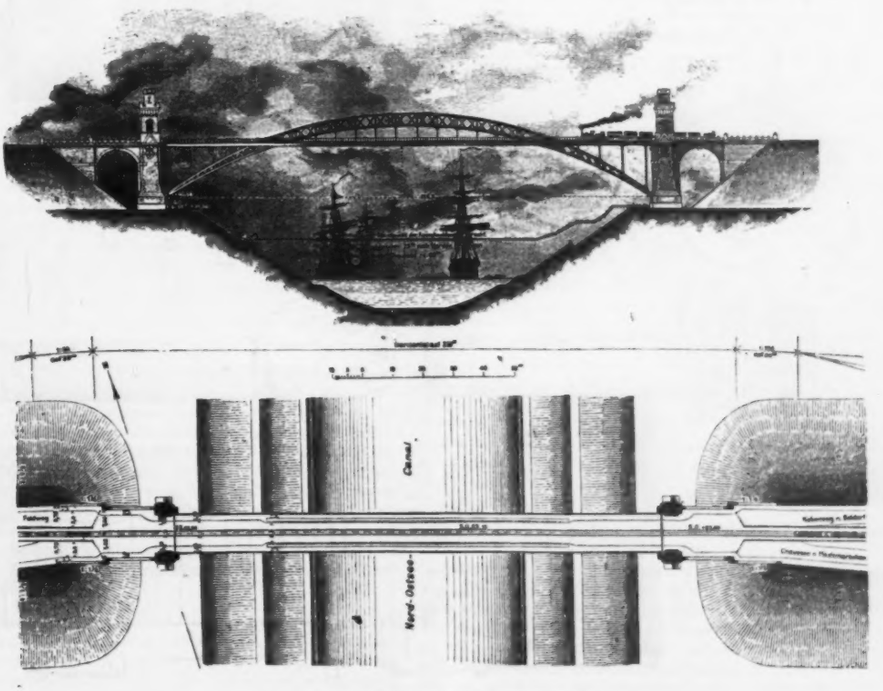


FIG. 6.—BRIDGE AT GRUENENTHAL.

way is 26 ft. wide, containing the railway track as in the center of the span, and the foot walks are 7 ft. wide.

The track has a slight rise, amounting to 4 ins. at the lowest and 10.8 ins. at the highest temperatures. The trusses are inclined toward each other at an angle of 1:⅓. They are 13.4 ft. deep at the center, and are hinged at the abutments only. The chords are circular arcs of 492 and 443 ft. radii. The center rises are 70.3 and 93.9 ft., respectively.

The ironwork was designed by Railway Inspector GREVE, of Kiel, and the abutments by Government Architect EGGERT, of Berlin. The Gustavsburg Bridge Works, near Mainz, have the contract for furnishing and erecting the ironwork.

Durability of Lake Vessels.

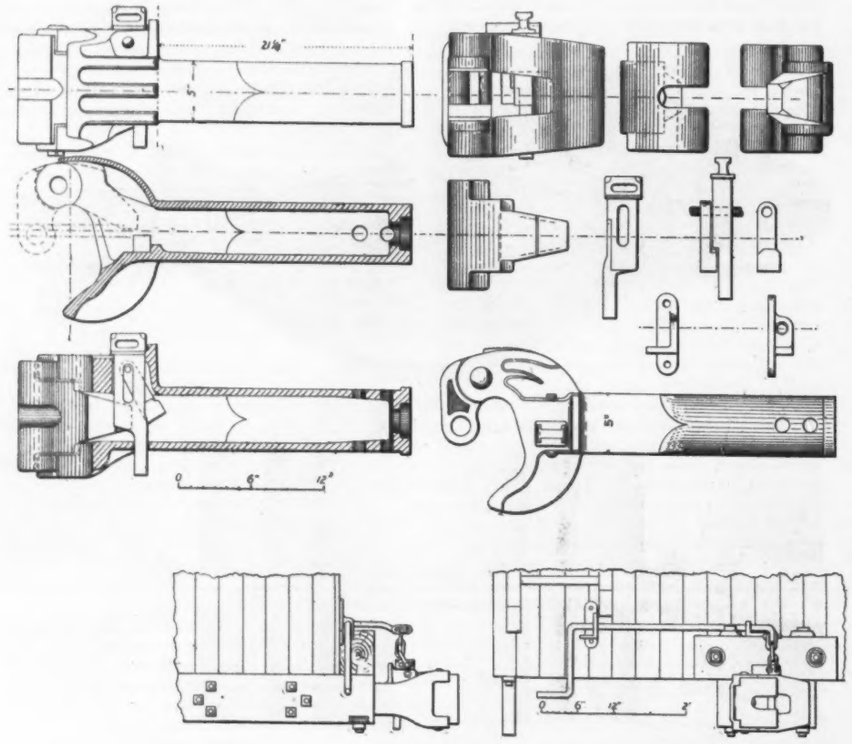
We are indebted to Mr. J. M. GOODWIN, Member of the Ship-Canal Commission of Pennsylvania, for the following statement of the life of vessels on the Great Lakes: Of vessels, having carrying capacity of 200 tons or more, that were in service on the Northwestern lakes in the season of 1889, several had then been afloat for more than 40 years. More than 50 had been in service for over 30 years.

The subjoined table, which perhaps does not include *all* the old-timers, shows 117 vessels that were more than 25 years old in 1889.

Built.	Schooners.		Steamers.	
1844	168 T. gross	1		
1847	188 "	1		
1848	227 "	1		
1853	154@3 0 "	8		
1854	179@390 "	12		
1855	214@402 "	8		
1856	192@406 "	18	428 T.	1
1857	201@500 "	9	232@909 "	3
1861	291@327 "	6		
1862	291@542 "	22	531@1115 T.	4
1863	2 5@585 "	17	656@1110 "	2
1864	288@604 "	3	1431 "	1
Total.		106	Total.	11
Aggregate vessels				117

The Hinson Car-Coupler.

This car-coupler is of the M. C. B. type, and its distinctive and important feature is that, for top-unlocking, provisions are made for longitudinal motion of the drawbar to a sufficient amount, without using a chain so long that it will drop into dangerous places when slack.



The Hinson Freight Car Coupler.

This is effected by a 2¼-in. slot in the top of the lock, and a 1¼-in. slot in the arm of the unlocking rod. The chain is made up of two clevises and one link, 7 ins. in total length. With a radius of 7 ins., with 7-in. slack, a forward motion of the bar of 5 ins. is secured, bringing the chain tight; and there would be the same amount backward if the bar could be sent back that distance. In the old form of attachment the giving way of the draft-rigging, after it has been used awhile, exerts a puling strain, and loosens or breaks the chain. It is not an uncommon thing to see a bar pulled out 3½ to 4 ins. from its normal position under this strain, and the present device is intended to provide for this service condition.

The lock in this coupler is operated by positive gravity, and is held in position by a trip with a shoulder, which hangs in the pathway of the arm of the knuckle. It is a very strong coupler with a positive action, and as it is not operated by the arm on the knuckle it is not subject to abuse. The knuckle is made of the best open-hearth steel, and the metal is well distributed, as is shown in the cuts. The manufacturers are: The Hinson Car Coupler Co., The Rookery, Chicago, Ill.

A CAR SCALE, attached to the frame of the car and intended to weigh the contents alone, is being introduced by the Wanamaker Car Scale Co., of Indianapolis. The body of the car is lifted by hydraulic jacks in a few minutes, and the weight is then thrown upon a system of compound levers resting upon the truck bolsters. An experimental car is built and is being taken about the country as an exhibit of the device.

THE "WHALEBACK" STEAMER that is now at Liverpool loading is, says its inventor, Capt. MACDOUGALL, only a type of a larger class still of these odd boats. He says he will shortly commence building a "whaleback" 450 ft. long for service during the World's Fair, and after that cut it in two and send it down to the sea. It will be fitted up for passengers and be given great speed. Others may then follow.

LIGHT CARS FOR SUBURBAN TRAVEL have been made by the Wason Car Manufacturing Co., of Springfield, Mass., that are 40 ft. long, will hold 48 passengers seated and weigh only 30,000 lbs. By an arrangement of straps like on the elevated cars in New York, as many more passengers can stand. These cars are fitted with Miller platforms, automatic couplers and have the Wood's gate on platforms. The inside is handsomely finished in mahogany.

PROPOSALS FOR CARRYING THE U. S. MAIL, under the new subsidy law, were invited by the Postmaster-General on July 15. These proposals are for the transport of the American mail to foreign ports in vessels of American build, of the best construction and highest speed in their respective classes. As showing what the present conditions are it is stated that in the fiscal year 1890 just 60 cents were earned by American ships for carrying United States mail to Europe, and during the same period foreign ships were paid $397,668.40 for this service. The Postmaster-General wants to put a first-class, rapid weekly service on two transatlantic routes, one to England and one to a continental port. He also wants to improve the mail service to South and Central America, Australia and Asia. The advertisement issued calls for about 30 routes. The new service would require the building of many new ships, probably 5 of the first class, 17 of the second class, 5 of the third and 4 of the fourth class, with an aggregate tonnage of 154,000 tons, and at an estimated cost of $27,000,000 to $30,000,000. These ships would be needed for the routes to Panama, Buenos Ayres and Venezuela alone. The bounty to be granted by the government would be: Per mile of the shortest practicable outward passage, first class, $4.00; second class, $2.00; third class, $2.00, and fourth class, $0.66. There are pro-rata reductions for failure and irregularity in service.

THE TAMPICO HARBOR IMPROVEMENTS are reported to be in the following stage of progress in San Antonio dispatches of July 13: The work is being done under a subsidy from the Mexican Government. The north jetty is now 5,835 ft. long, and the south jetty 5,340 ft. long. It will require a length of 7,000 ft. to bring them into 24 ft. of water. The width between the jetties is 1,000 ft., the bar being of sand and mud. The river in flood has a discharge of 225,000 cu. ft. per second, and this discharge is to be depended upon to cut the 25-ft. channel desired. Work was commenced in June, 1890. Since then 1,400 ft. of beach has been made on each side of the jetties. About 1,000 to 1,400 men are at work, and about 700 cu. yds. of stone are dumped daily in the jetties. The brush mattresses are 70 × 85 ft. at the bottom and 30 ft. wide at the top, and the piling used is brought from Pensacola, Fla., and Pascagoula, Miss. The average current in the Panuco River is 3 miles per hour, and this stream has a depth of 25 ft. for 80 miles inland to the town of Tamos.

THE SOUTH PASS CHANNEL, at the mouth of the Mississippi River, is thus reported upon for the past year by Major J. B. QUINN, U. S. Engineers: 30 ft. of water was maintained for the year, excepting for 15 days only, when the channel for 3 days in April was only 25 ft. deep, and for 12 days it had a central depth of 27.5 to 29.4 ft. Beyond the end of the jetties the most direct channel varied from 26 to 31 ft., but in the channel turning to the eastward a depth of more than 30 ft. was maintained during the year. In Grand Bayou Reach the least depth was 27 ft.; and the least width of the 26 ft. channel was 160 ft. In the fan-shaped area beyond the jetties the average shoaling was 2.7 ft. during the year. The amount expended in the year ending June 30, 1891, was $11,042.

FOR THE IMPROVEMENT OF THE RIVER AT JOHNSTOWN, PA., the City Councils appropriated, on July 17, the sum of $50,000 for the widening of the river and $50,000 toward the improvement of the town. Work on the river is to begin at once, on the general plans prepared by Mr. J. J. R. CROES, C. E.

THE NEW YORK AND NEW JERSEY BRIDGE CO. opened its books for subscriptions in Jersey City this week. The purpose of the subscription was to bridge the Hudson River, the capital stock being fixed at $2,000,000, with the privilege of raising this to $5,000,000. As far as can be learned the subscription was small, if any money was secured at all.

THE *Howard Carsard* is a new steamship just completed by the Arrow Steamship Co., or, as it is now called, the Monumental Construction Co., of Baltimore, Md. This new ship is built upon the de-

signs of Mr. FRYER, and is intended to illustrate a new type of express ocean steamships for carrying mail, passengers and express matter only. Speed, safety and cheapness in construction and operation are the advantages claimed. The *Howard Carsard*, commenced in May, 1890, is 222 ft. long over all, with "16-ft. beam," and is driven by a single compound engine of 30 and 60-in. cylinders, 24-in. stroke. The special feature of construction is the keel, which is 15 ins. deep at the bow and 48 ins. at the stern; it is 5 ins. thick and built of plates and angles, and weighs 68,000 lbs. Over this are saddled cross-sectional, solid bulkheads, and these are connected by longitudinal walls of iron in such a manner as to make an exceedingly strong cellular hull. The engine frame is part of the cross-bulkheads amidship. All the weight of machinery, etc., is at or near the bottom, with the center of gravity of the unloaded boat 14 ins. below the water line. Great stability is claimed, notwithstanding the very narrow beam.

THE MASSACHUSETTS LAW REQUIRING THE USE OF FENDERS ON STREET CARS, of such form as the State Railroad Commission should require, has been repealed. In their last report the Commission asked for the repeal of the law, not because fenders were not needed, but because it was impossible to prescribe an efficient fender unless control could also be had over the roadway between the rails and over the type of car used.

A STREET-RAILWAY SPRINKLING CAR is said to be under construction by the Minneapolis Street R. R. Co., to sprinkle the track along the electric line between St. Paul and Minneapolis.

THE COLORADO LAKE promises to be permanent unless something is done at once to check the flow from the Colorado River. Explorers say that should the channel be cut a little deeper the water from the Gulf of California would find its way into the desert. These explorers report, however, that all the breaks and crevasses along the Colorado could be closed by sheet piling.

DAILY RAILWAY TRAFFIC IN LONDON, as taken at the last census and compared with that of 1881, is given as follows by London, *The Railway News:*

	1891.	1881.
Great Eastern, Liverpool St.	52,413	33,890
North London, Broad St.	43,042	30,440
Metropolitan Ry., Bishopsgate	13,180	9,325
Totals	108,635	73,655

These figures only give the passengers entering the City of London, and nearly all of these are carried out again in the evening. Including up and down trips, the elevated roads of New York alone now carry about 500,000 passengers each day.

THE COST OF THE MANCHESTER SHIP CANAL, as now revised, is in total about $45,000,000. The original estimate was $25,000,000, including Parliamentary expenses to the amount of $750,000 expended in three years' combat with a vigorous opposition party. This canal is 35½ miles long, and the cost is thus about $1,270,000 per mile. The minimum width on bottom is 120 ft., and maximum width at water surface 230 ft.; depth 26 ft. The largest lock is 660 × 80 ft. The canal was dug through red sandstone, clay and sand, and the deepest excavation was 66 ft. It is estimated that 70 vessels per day can pass the locks. About 3½ miles of the canal was opened to traffic on July 16, and the late passage of a bill appropriating $15,000,000, advanced by the city of Manchester, will insure its speedy completion. Of the whole canal 76% is finished.

THE FIRST COTTON GIN, MADE BY ELI WHITNEY, and the original patent granted to the same inventor and signed by WASHINGTON as President of the United States, are in the possession of the New Orleans Machinery Company. It is interesting to note in connection with this machine that in 10 years after its introduction the value of the cotton crop in the United States increased from $150,000 to $8,000,000.

THE METROPOLITAN SEWER, which is to drain a number of towns about Boston, according to the act of 1889, is about in the following condition of progress: On the "North system," with its outlet at Deer Island, Sections 1, 2, are 9 ft. in diameter and were let in June, 1890, to the National Construction Co., and they were to be completed on April 30, 1891. The Winthrop sections, aggregating 14,435 ft. in length, were let to the Metropolitan Construction Co., and they were all to be finished by July 31, 1891. Only one section is finished, but the rest will be by Sept. 1. The Breeds Island section, 4,100 ft. long, CHARLES LINEHAN, contractor, is also behind time but will probably be finished late this fall. The same contractor has the work on the East Boston section, 3,700 ft. long, and this may be finished in October. This entire length of sewer is 9 ft. in diameter, with an interior lining of hard brick. The walls are from 12 to 33 ins. thick, backed with concrete on the sides. The next section to be completed will be at Chelsea; but this work has just been commenced. On the Charles River Valley system, section A is 3,700 ft. long and the diameter is 5½ ft.; section B is 3,000 ft. long and the same diameter as A; section C is 5,800 ft. long and 4 ft. 10 ins. and 5 ft. 3 ins. in diameter; section D is 5,400 ft. and 4 ft. 10 ins. in diameter. The contractor for all four sections, H. C. EYRE for sections A and B, and the National Construction Co. for C and D, are somewhat behind time, but they will complete the work this fall. Section E, along the Charles River to the Newton line; section F, through Newton; section G, Newton to Waltham, it is expected will all be finished by Nov. 1 next. This Charles River Valley sewer commences with a diameter of 3 ft. 9 ins., in Newton, and enters the Boston main sewer, at Huntington Ave. and Barker St., with a diameter of 6 ft. 6 ins.

MOLASSES AS A FUEL is seriously suggested by *The Planter*, of New Orleans. The large sugar crop of Louisiana for the present year promises increased trouble in getting rid of the lower grades of molasses, the output of which will probably reach 300,000,000 lbs. This molasses is sold for 5 to 7 cts. per gall. when a customer can be secured; but the bulk of it is wasted by either running it into huge pits or into the river and bayous. It was formerly converted into rum, and this would seem to be a profitable enterprise at present prices. But *The Planter* now proposes to use it as a substitute for coal as fuel on the plantations. This journal figures out that the lowest grades of vacuum pan molasses contain from 20 to 25% of sugar, which cannot be extracted by existing machinery. Estimating a barrel of such molasses to be worth, net, 50 cts. or $1, and a barrel to hold 550 lbs. of molasses, the molasses would be worth 1 or 2 cts. a gall. and from $\frac{1}{11}$ to $\frac{1}{5}$ ct. a pound. Pittsburg coal brought to the sugar-house furnace has for about 10 years cost ½ ct. per pound. This molasses burns with a high heat in combination with wood or wood fiber, so that by sprinkling it on the *bagasse* (the dry stalks of the sugar cane after the saccharine juice has been pressed from it) an excellent fuel of great heat power is obtained. In this way, estimating that only half the molasses produced is used for fuel, a substitute will be furnished for 75,000 to 100,000 tons of coal. That is more than enough for the manufacture of all the sugar of Louisiana.

THE OHIO STATE UNIVERSITY, at Columbus, O., is erecting two new buildings this year, has just created 3 new departments, has added 2 more professors in agriculture and botany, and in other respects is advancing rapidly to a place among state universities of the first rank. The range of instruction includes courses in arts, philosophy, modern languages, science and agriculture; in civil, mechanical, electrical and mining engineering, and in veterinary medicine and pharmacy. The teachers of all branches number 45. A catalogue giving full detail is issued.

ANOTHER GRAND CAÑON EXPLORING EXPEDITION is about to start from Green River, under the command of Capt. H. MCDONALD, says a dispatch from Grand Junction, Colo. The purpose of this party is not stated, but it is supposed to be chiefly interested in mineral development.

THE GROWTH OF LONDON from 1801 to 1891, according to the various census returns as compiled by the *Pall Mall Gazette*, is as follows:

Population.		Population.	
1801	958,863	1851	2,362,236
1811	1,138,815	1861	2,803,989
1821	1,378,947	1871	3,254,260
1831	1,654,394	1881	3,815,704
1841	1,948,417	1891	4,211,056

The rate of growth has constantly decreased since 1851, it being 19% between 1851 and 1861, and 10.4% between 1881 and 1891. The increase in population for the last decade has been confined largely to the eight southern registration districts. The population of the four central districts shows a considerable decrease. The area of the metropolis is now 75,334 acres.

THE HARRIS PRIVATE CAR "Jeannette," built on the Harris patent for palace cars, has been running over railways in all parts of the country to exhibit the special features of its construction. The principal novelty is in the arrangement of the sleeping, berths, which during the day are lowered into pockets below the floor, the bottom part of the floor being 14 ins. lower than usual between the trucks. In this way the interior of the car is kept clean and roomy during the day, while at night the movable chairs and passengers' baggage are placed in the "pockets." The pockets are 6 ft. long, and the part of the floor covering each one is hinged at one end to form a partition between two sections when the berths are made up. The berths are raised and lowered by a crank, operating a worm and spur gear, gearing with a vertical rack at each end of the berth. By this arrangement there is more headway than usual between the two berths. Special heating and ventilating appliances are used. Cars built on this plan are said to be lighter and cheaper than ordinary sleeping-cars, while at the same time they are stronger in construction, accommodate more passengers and have advantages in comfort and convenience. This type of car is the invention of Mr. L. J. HARRIS, who is General Manager of the Harris Palatial Car Co., of Boston, Mass. The "Jeannette" was built by the Wason Car Mfg. Co., of Springfield, Mass. The Harris company is now preparing plans for 5 other cars, with some modifications in the design, which it is intended to run as a solid train for long-distance excursions, the combination of a clear interior by day, sleeping-berths at night and buffet fittings making them especially adapted for excursion and special service.

A CHICAGO-ENGLAND STEAMSHIP LINE is the object of a British syndicate lately formed. This company proposes to use vessels that will pass through the Canadian locks and canals, and establish continuous water communication between Chicago and English ports. The London *Financial News* says that $5,000,000 has been subscribed, and that the fleet will consist of 10 steamers of 1,500 tons each, fitted with refrigerating apparatus for the transport of dressed meat. The winter terminus of the vessels of this Great Lakes Navigation Trading Co., Limited, would be at Portland, Me.

A SINGLE-RAIL RAILWAY, on the Lartigue system, is to be built, according to report, from Feurs to Parricsierés, France. The line will be about 10½ miles long. This system consists of a series of A frames resting on the ground and carrying the rail upon the top, while guide rails along the side serve to steady the train. The engine and cars straddle the track, the latter having longitudinal seats, the passengers sitting with their backs to the track. A railway on this system, 10 miles long, has been in operation for some time in Ireland. It is reported that the French government has sent a commission to Ireland to inspect this line, with a view to adapting the system for lines in the French colonies, and that the engineer of a railway in India has also recently inspected it with a view to adopting the system for feeders to the railway.

THE GREAT COST OF ENGLISH RAILWAYS, in land damages alone, is illustrated by the fact that the proposed new Lancashire, Derbyshire & East Coast Ry. is estimated at about $207,500 per mile. Of this amount $140,500 per mile will be required for land purchase alone. The remainder, $67,000, is not excessive for a first-class, well-equipped modern rail way with many large towns on its line.

TUBULAR-FRAME FREIGHT CARS are being built by the Tubular Frame Wagon Co., of England, for the Great Northern and Furness railways, England; the Waterford & Limerick, Great Northern and Tralee & Dingle railways, Ireland; the Aranco Ry., Chile; the Southern Ry., Spain, and for German and Italian railways. Some of these cars have been built in New South Wales for the New South Wales government railways. They weigh about 8 or 9 tons and carry a load of 25 to 30 tons, while the ordinary short cars on these railways weigh 4 to 5 tons and carry a

load of about 7 tons. The patent parts of the iron-work were sent out from New York.

THE COLUMBIAN WORLD'S FAIR BUILDINGS are about in the following stages of progress, according to the report just issued by Chief of Construction D. H. BURNHAM: The foundations for the Mines and Mining Building and the Woman's Building are well under way, with plenty of material on hand; the foundations of the Electricity Building are commenced, and it is expected that the Manufacturers' Building will be commenced very shortly. Contracts were let on July 13 for the Administration buildings, and proposals for the Fisheries Building were opened on July 14. Bids for the Machinery Building will be called for in about 2 weeks, for the Agricultural Building in a few days and for the Art Building on Aug. 1. There are about 600 to 700 men at work now on the grounds, and this will be increased to thousands in a short time. Hiero B. Herr & Co., the contractors for the Casino pier, are now driving piles for this structure, and Shailer & Schinglau are driving piles for the government pier in the lake. Up to date 26,700 lin. ft. of tracks have been laid. The Multiple Speed & Traction Co. is preparing to put down its trial track. In grading the grounds 600,000 cu. yds. of earth have been removed, and there is little left to be done. Contracts have been let for two railway and one road bridge, and these are being built. The water-supply plans are now about worked out, as are the sewerage plans.

AMMONITE, THE NEW EXPLOSIVE, is intended for mining, blasting and quarrying operations. It is a mixture of ammonium nitrate and mononitro-naphthalene in the proportions 81.5 to 8.5, according to to Col. CANDILL, and is similar to Favier's explosive. The cartridges are hermetically sealed in a thin lead casing, with an attachment for the fuse at one end. It did not explode from shock until the second blow, at a recent trial, with a 50 lb. weight falling on an iron plate from a height of 5 ft. It did not seem to be injured by freezing; did not explode when thrown into a fire, and was instantaneous in action.

A CALCINED INFUSORIAL EARTH FILTER has been invented by Mr. BARKEFELD, a German engineer. It is made of fossil-meal or diatomaceous earth, and in the form of a hollow cylinder. Careful investigation shows that the cavities occupy about 65.7% of the bulk, and each pore is filled with very fine spiculæ crossing each other. As it is a very bad conductor of heat, it has to be put into cold water and then have this water raised to the boiling point when it is desired to sterilize it. It will yield a desirable filtered water at the rate of about ¼ gall. per minute, and by mechanical cleaning can always be restored to its original condition. It is claimed that its rate of filtering is far in excess of any house filter that will really produce water free of germs.

THE LATE BREAK IN THE MANCHESTER CANAL, according to an account sent us by one of the engineers of the canal, did not reach the serious proportions represented by many of the English and American papers. The purpose was to close a gap of about 250 ft. in length, in one tide, and all would have gone well if a train of loaded cars had not been derailed at a critical moment. With the dimensions given, it is hardly necessary to say that "the millions of tons" of material washed away existed only in the vivid imagination of the English reporters. There was some delay and some scouring, but hard work made all secure again.

THE METROPOLITAN RAILWAY OF LONDON, says *Herepaths*, received for the half-year ending June 30, 1891, the total sum of $1,764,140 from the City lines and extensions, and the total expenditure was $729,580, leaving a profit of $1,034,560 for the half-year. The dividend declared is at the rate of 3¼% per annum. A table submitted with the report shows that the traffic began in 1863 with 9,455,175 passengers; rose to 15,763,907 in 1865, to 39,160,849 in 1870, to 48,302,324 in 1875, to 63,759,573 in 1880, to 77,170,601 in 1885, to 84,289,282 in 1890; and for the first 6 months of 1891 it was 43,587,742.

WATER AVAILABLE FROM SANDY SOIL.—According to experiments made at the Hague, which obtains its water from the sand dunes, from 30 to 50% of the rainfall can be collected, varying with the season. In summer much of the rainfall goes to feed vegetation, or is evaporated before it can penetrate the soil; under the reverse of these conditions the greater proportion of the water falling is obtained in winter. These sand dunes have the power of attracting atmospheric vapor not precipitated in the form of rain, as is proved by the fact that after long droughts damp sand is found near the hilltops, while the lower layers are dry. This water is gathered by porous drains leading to the pump well, and to prevent the pump valves from choking with sand the suction pipes are placed in a column formed of shells, which only permit a slow, constant motion in the water passing through, and prevent any strong local currents.

CERTAINLY COMPETENT.—Not long since, in an arbitration case an engineer was thus examined as to his professional experience and capacity: "How long have you been in the profession?" "Twelve years." "Are you thoroughly acquainted with your work, theoretically and practically?" "Yes." "Do you feel competent to undertake large constructions?" "Yes, most certainly." "In what engineering works have you been engaged during the last 12 years?" "The manufacture of iron bedsteads."—*Toronto Monetary Times.*

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Portsmouth & Concord.—Chief Engineer A. W. Dudley has begun the survey of the proposed line from Exter to Epping, N. H.

Little Falls & Dolgeville.—Trouble between the contractors has delayed work on this New York road. It will take about a month to finish the line.

Baltimore & Ohio.—Work on the Akron & Chicago Junction R. R. is now practically completed. It has been decided to put on two through freight trains on Aug. 3, and get out a regular schedule to begin running passenger and freight trains on Aug. 10. About all of the depots will be completed by that date, and the roadbed will be in first-class condition. Construction and special trains have been running over the road for about a week.

Toledo & Chicago Bee Line.—A press dispatch says:

Donald McLean, General Manager of the proposed Toledo & Chicago Bee Line, says there will be no delay in constructing the road. The contract has already been let for building the first 70 miles of the line eastward from Toledo, and the work of construction will be pushed as rapidly as possible from this time until the coming of cold weather.

Lehigh Valley.—It is reported that work has begun on the line from Berwick to White Haven, Pa., 12 miles.

Brooklyn & Rockaway Beach.—This company has completed the plans for the proposed improvements of its roadbed and rolling stock. The line, which runs from East New York to Canarsie, 3.5 miles, will be double tracked and new stations and terminals will be built. The rolling stock will be increased and two steamers will be purchased. The company will issue $350,000 of bonds to provide the necessary funds for these improvements.

Rockaway Valley.—An effort is being made by the people along the route to secure the construction of this road from Mendham to Morristown, N. J., about 25 miles. The city of Morristown is asked to subscribe $40,000 in its aid.

Projects and Surveys

Bradford & Western Pennsylvania.—Chartered in Pennsylvania to build a railway from Lewis Run, on the Buffalo, Bradford & Pittsburg R. R., to a point near Marshburg, McKean County, Pa. The directors are: C. S. Whitney, Belmont, N. Y.; H. S. McMullen, Frank L. Richardson and H. P. Whitney, of Bradford, Pa.

Roxborough.—Surveys have been begun on this railway, noted in our last issue. The road will be 10 miles long and it is expected to have it completed within one year. Nearly all of the right of way has been secured. The incorporators are William F. Dixon, John C. Klander, William J. Donohoe, Charles L. Hamilton, Jacob S. Fry, Frank S. Cantreel, P. K. Royer, George W. Shick and Charles T. Jones, Jr.

Michigan & Mackinaw.—This company has been chartered in Michigan with a capital stock of $1,280,000.

New York.—A press dispatch says:

A party of London, New York and Philadelphia capitalists were in Carthage, N. Y., looking over the ground with a view of building the connecting link between the Northern Adirondack, Carthage & Adirondack and the Elmira, Cortland & Northern railways, via Watertown and Camden, and making a connection through to Canada.

Au Sable & Northwestern.—A railway company by this name has been chartered in Michigan, with a capital stock of $56,000.

Bay City & Port Huron.—The project to build a railroad from Bay City to Port Huron, Mich., is again being agitated. Carl. C. L. Wulff, of McClure, O., and H. Van Campen, of Napoleon, O., are interested.

Chicago, Union City & Huntington.—The officials of this proposed railway from Union City to Huntington, Ind., 70 miles, are canvassing the towns along the route for subscriptions in aid of the enterprise.

Detroit & St. Clair River.—Vice-President C. McElroy writes us that surveys are now in progress for this railway between Detroit and Port Huron, Mich., 60 miles. President, Warren H. Loss; Chief Engineer, J. Graham Gribble; both of New York City.

Pittsburg, Cannonsburg & State Line.—This company, which proposes to build a railway from Pittsburg, Pa., to Wheeling, W. Va., has secured the right of way and a subscription of $5,000 per mile for 20 miles of its line. A. B. Paul is Secretary and Chas. Meyran is President; both of Pittsburg.

SOUTHERN.—Existing Roads.

Macon & Atlantic.—Work has been resumed and is being rapidly pushed. The contractors have 200 men and 150 teams at work, and they expect to finish about 20 miles of road per month. The grading is nearly completed. It is expected to have the section from Brewton to South Bound, 85 miles, completed by Nov. 1. About 13 miles of the track were laid before work was discontinued some months ago.

Orlando & Winter Park.—Construction has been begun on the extension from Orlando to Rock Ledge, Fla., via Oviedo. The line is to be completed ready for business next season. J. O. Turner is Chief Engineer.

Abbeville & Way Cross.—Five miles of track from Bowens Mills, Ga., south have been finished and arrangements are being made to lay 5 miles more.

Ohio Valley.—The citizens of Hopkinsville, Ky., will soon vote on the proposition to subscribe $115,000 in aid of the proposed extension of this railway from Princeton to Hopkinsville. About $22,000 has been privately subscribed.

West Virginia & Pittsburg.—Work on the line from Braxton C. H., W. Va., to the Gauley River in Braxton Co. is making rapid progress. It is to be completed and in operation next spring. Arrangements have been made to extend the line from the Gauley River south 35 miles to a connection with an extension of the Warm Springs Branch of the Chesapeake & Ohio R. R.

Chesapeake & Ohio.—This company will extend its Warm Springs Branch to the Gauley River, where connection will be made with the West Virginia & Pittsburg R. R.

Projects and Surveys.

Oxford & Coast Line.—It is announced that construction will soon be commenced on this line from Oxford to Wilson, N. C., 60 miles. H. C. Henderson, of Oxford, N. C., is interested.

Glade Creek & Raleigh.—Chartered in West Virginia to build a railway from Glade Station, on the Chesapeake & Ohio R. R., up Glade Creek and down Little and Big Beaver creeks to the mouth of the latter, near Raleigh. Among the incorporators are Lewis M. Robertson and Burton B. Wright. The principal offices will be at Crow, Raleigh Co., W. Va.

Carabelle, Tallahassee & Georgia.—A press dispatch says: The Carrabelle, Tallahassee & Georgia Ry. Co. has been reorganized by the election of the following officers: President, Milton Saylor, of New York; Vice-President, Fred T. Myers, of Tallahassee; Secretary and Treasurer Robt. Cumming; General Manager, A. Orr Symington; Directors, Wm. Clark, Wm. K. Klare, Robt. Cumming and Milton Saylor, of New York, and Fred T. Myers, of Tallahassee. It is said that the work of construction will be resumed.

Chepola & Chippewa Lake.—The officers of this company, which was recently chartered to build a railway from Marianna, Fla., to the Alabama state line, with branches to Chippewa Lake and St. Andrews Bay, are: President, E. T. C. Dickenson, of Greenwood, Fla.; Vice-President, J. T. Davis, of Columbia, Ala., and Secretary, W. H. Milton, Jr. The State of Florida has granted the company 10,000 acres of land per mile of railway.

Nashville & Harriman.—Chartered in Tennessee to build a railway from Harriman, Tenn., west to Nashville, and southeast to the East Tennessee, Virginia and Georgia R.R. Among the incorporators are W. H. Julien, of Harriman, Tenn., and W. T. Smith, Nashville.

Kanawha Valley.—This company, recently chartered to build a railway from Parkersburg, W. Va., up the Little Kanawha River, has begun securing the right of way. Superintendent, W. A. McCosh, Parkersburg, W. Va.

Georgia.—The following bills have been introduced into the Georgia State Legislature: to incorporate the Atlanta, Hopeville & Manchester R. R. Co., the Atlantic, Americus & Florida R. R. Co., the Washington & Middleton R. R. Co. and the South Atlantic R. R. Co.

NORTHWEST.—Existing Roads.

Pacific Short Line.—The sale of this road has been decreed by the United States Court, and will take place at Omaha, Neb., Sept. 1.

Chicago, St. Paul, Minneapolis & Omaha.—It is rumored that this company will extend its Sioux Falls & Mitchell branch into Charles Mix Co., South Dakota.

SOUTHWEST.—Existing Roads.

Texas, Louisiana & Eastern.—About 10 miles of this road, from Conroe, Tex., east, is now under construction,

and the company expects to have 20 miles completed in 3 months.

Chicago & Kansas City.—The old Chicago, Kansas City & Texas R. R. Co. has been reorganized under the above name, and it is stated that its road will be extended.

Projects and Surveys.

Paris, Choctaw & Little Rock.—At a recent meeting of the directors the following officers were elected: President, R. F. Scott; Vice-President, T. D. Craig; Chief Engineer, C. G. Woodbridge; Secretary, B. J. Baldwin, and Treasurer, L. P. Harrison. It was decided to build the line from Paris, Tex., to the Red River, 30 miles, at once, and the chief engineer was ordered to begin locating the line and securing the right of way.

ROCKY MT. AND PACIFIC.—Existing Roads.

Great Northern.—Tracklaying has been temporarily suspended on the Seattle & Montana R. R., owing to lack of track material. It has reached a point 6 miles north of Marysville, which leaves 3½ miles to be completed.——The grading is completed on the Belt Mt. branch to Barker, and all bridgework will be finished within a week. Tracklaying will begin at once.

Silver City & Northern.—Nineteen miles of track have been laid upon this New Mexico railway.

Port Townsend Southern.—This company will probably build a branch from Tenino to Bucoda, Wash., to open up coal mines.

San Joaquin Valley.—The promoters of this railway have received a charter for the line. The road is projected to run from Fresno, Cal., northwest to the headwaters of the San Joaquin River, 100 miles. The line has been partly surveyed, and the contract let to Fitzgerald Bros., of Oakland, Cal.

Projects and Surveys.

British Columbia.—A charter has been granted by the Dominion Parliament to capitalists of New Westminster to build a road from the boundary to Vancouver, via New Westminster, under the name of the Burrard Inlet & New Westminster Ry. Work will soon begin, and in six months the road will be well toward completion. The road is to be built to open up the country south of the Frazer River in the interests of the New Westminster, and in opposition to the Canadian Pacific, which it is claimed has discriminated in favor of Vancouver.

CITY TRANSIT.

Electric Railways.—New lines or extensions of existing systems are reported as probable in the following places: Homestead, Pa.; Kenosha, Wis.; Concord, N. H.; Crossville, Tenn., address H. V. B. Smith; Oakland, Cal., address J. W. Hearst; Seattle, Wash., address F. E. Sander; Sacramento, Cal., address R. S. Carey; Indianapolis, Ind., address W. T. Cox; Brownwood, Tex., address the Brownwood Improvement Co.; Hillsboro, Tex.; Brandon, Man.; Hammond, Ind., address the Heimback Street Ry. Co.; Sutter Creek, Cal.; Danville Ill.; Williamsville, N. Y.; Santa Barbara, Cal.

Toronto, Ont.—The City Council has leased the street railway to G. W. Kiely and W. McKenzie, of Toronto; H. A. Everett, of Cleveland, and C. C. Woodworth, of Rochester, for $1,453,009 and 8% of the gross receipts. The lease is said to be for 30 years.

Lockport, N. Y.—The Lockport Street R. R., which has not been in operation for nearly 7 months, will resume running as an electric line.

West Orange, N. J.—The Township Committee held a conference on July 25 with the officers of the Newark Passenger Ry. Co., and the lines of the road as laid down were accepted with a few slight modifications.

Detroit, Mich.—The Detroit Street Ry. and the Grand River Street Ry., having a combined length of nearly 80 miles, have been bought by a syndicate of Boston and New York capitalists. W. W. Cook, of New York, will become President of the new company, and W. D. Ferguson, of Boston, will become Vice-President. The new owners will, it is said, change the motive powor on all the lines to electricity, which will throw some 2,500 horses on the market.

Racine, Wis.—The Belle City Street Ry. will, it is said be sold to a syndicate of St. Louis parties headed by C. H. Holmes, provided the City Council will grant permission to build 7 more miles of line and to adopt electric motive power. The price is understood to be about $90,000.

Oakland, Cal.—The stockholders of the Oakland Consolidated Street Ry. Co. have voted to issue $500,000 of bonds for constructing a cross-town electric line and purchasing the franchises and property of the Oakland & Berkeley Rapid Transit Co.

Berkeley, Cal.—A survey has been made for a line skirting the foothills above Piedmont and connecting Berkeley and Mills Seminary.

Seattle, Wash.—The Seattle & White River Valley Electric Ry. Co. has been organized with a capital stock of $1,500,000, although not yet incorpoated, to build a line between Seattle and Tacoma. This is an old project, but L. H. Griffith, of this city, and others, who have already held meetings and solcited subscriptions, have met with considerable encouragement. The line will extend from Seattle to Sumner, and there connect with the Puyallup line owned by R. F. Radebaugh.

Horse Railways.—New lines or extensions of existing systems are reported as probable in the following places: Philadelphia, Pa., address the Philadelphia Traction Co.; Sumter, S. C., address D. M. Graham; Kingsland, Ark.; Hot Springs, Ark., address R. Murray & Co.; Salem, Ore., address J. H. Albert; Winnipeg, Man.

Sumter, S. C.—D. M. Graham wants to correspond with companies furnishing street-railway equipment.

Lake Charles, La.—Wm. Meye, Secretary of the Lake Charles City R. R. Co., wants prices of cars, rails, etc.

Montgomery, Ala.—A franchise has been granted P. W. Smith and his associates to construct and operate a horse or electric railway on a number of streets.

Dummy Railway.—*Omaha, Neb.*—At a recent meeting of the Chautauqua Executive Committee, F. H. Hill and H. F. O. Gleason were appointed a committee to solicit subscriptions for a line to the assembly grounds.

New Companies.—Citizens Gas & Electric Ry. Co., Danville, Ill.; capital stock, $160,000; incorporators, J. R. Kendall, W. Beckwith, H. W. Morehouse. Mt. Pleasant (Pa.) Electric Street Ry. Co.; capital stock, $50,000; incorporators, D. S. Jordan and others. Spring Hill Street Ry. Co., Allegheny City, Pa.; capital stock, $12,000; incorporators, Morris Einstein and others. Ashland & Centralia Electric Street Ry. Co., Ashland, Pa.; capital stock, $20,000; President, J. E Reilly. Chicago & Evanston Electric R. R. Co., Chicago, Ill.; capital stock, $50,000; incorporators, J. L. Cochran, of Edgewater; D. H. Lauterbach, of Chicago; A. Clark, of South Evanston.

HIGHWAYS.

Pennsylvania.—Springfield township has voted $80,000 for highway improvements.—On Aug. 18 the borough of Clifton Heights will vote on a loan of $16,000 for a Telford road.

Kentucky.—Warren Co. will vote on an expenditure of $30,000 additional for turnpikes.

Colorado.—State Engineer Maxwell is making final surveys and specifications preparatory to advertising for bids for the state road through the cañon of the Grand River just below Hot Sulphur Springs. The last legislature appropriated $15,000 for this purpose. The road through the cañon shortens the distance over the "divide" just west of town about 3 miles, and also saves an ascent of over 800 ft.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Farmington, Me.*—The contract for the steel bridge across the Sandy River at this place has been let to the Pittsburg Bridge Co. at $12,850. The bridge has 3 spans 125 ft. long, 20 ft. roadway, one 5-ft. sidewalk.

South Meriden, Conn.—The plans for the iron bridge have been completed, and bids will soon be asked for.

Sutersville, Pa.—A company is being organized to build a bridge over the Youghiogheny River at this place.

Keokuk, Ia.—A bridge is to be built over the Mississippi River at this point.

Leavenworth, Kan.—Arrangements are being made to build an iron bridge over the Missouri River at this point. E. N. Morrill and A. J. Tullock, of Leavenworth, are interested.

Spokane, Wash.—Three bridges are to be built at this place costing $50,000, $45,000 and $38,000, respectively. Osker Huber, City Engineer.

WATER-WORKS.

NEW ENGLAND.

Brewer, Me.—F. H. Clergue, Secretary, of Bangor, has sent the following:

The Public Works Co. has acquired the plants of the Brewer Water Co. and of the Penobscot Water & Power Co., which now supply Brewer, Oldtown and Veazie. The Oldtown works is being extended to Orono, Milford and Bradley.

Pittsfield, Me.—The Pittsfield Water-Works Co. has organized with James F. Connor, Secretary. In case the town will not build works the company proposes to do so.

South Berwick, Me.—It is reported that surveys for works to draw a supply from Earle's Pond, about four miles distant, are being made by Engineer Jenkins. H. W. Burgett is said to be at the head of the enterprise.

Attleborough, Mass.—The district has voted to establish and operate a pumping plant. G. A. Dean, W. M. Stone and others have the matter in charge. The committee will report recommendations Aug. 21. Pumping is now done under contract by A. Bushbee & Co.

Easthampton, Mass.—City Engineer McClinton has reported on a new supply from Broad Brook, to be connected with the present system. Authority to improve the works has been secured from the legislature.

Manchester, Mass.—The Water Commissioners will receive bids until Aug. 5 for constructing a large well.

East Hartford, Conn.—The contract between the fire district and the East Hartford Water Co. for the building of works was signed July 27. Works must be completed by Sept. 1, 1892. Percy S. Bryant, Hartford, is connected with the company and J. J. Gleason with the district.

Wallingford, Conn.—The contract for the new supply main has been awarded as follows: From the gatehouse to Chestnut Hill, about 1¼ miles, to the Phipp Cement Pipe Co., New Haven, for $17,934; 621 tons of iron pipe to the Warren Foundry & Machine Co., New York, at $28.20 per ton, a total of $16,512.

MIDDLE.

New York.—G. N. Cowan, Stamford, has sent the following:

The proposed water companies at Cherry Creek and Sherman are not fully organized, and the works will not be built before next year It is expected that construction at Sinclairsville and Yorkshire Centre will be started this fall. The works at Hancock have been sold to local parties.

Buffalo, N. Y.—Bids will be received by the Water Commissioners until Aug. 11 for a 20,000,000-gall. pumping engine and four cylinder boilers.

Dryden, N. Y.—F. S. Jennings informs us that estimates for works will be made at once and a vote on the subject taken. The proposed supply is from springs to reservoir.

Tonawanda, N. Y.—There is talk of the purchase, by the village, of the company's works. H. J. Wende, E. H. Rogers, Sr., and others, have been appointed to negotiate with the company.

Plainfield, N. J.—J. M. Low, of Kingston, has been granted a franchise for works. The Plainfield Water Supply Co. has works nearly completed, and legal action will probably be taken if an attempt is made to build works under the new franchise.

East Greenville, Pa.—It is reported that works are to be built.

Scranton, Pa.—It is reported that the Gas & Water Co. will build a 3,000,000-gall. high-service reservoir at the head of No. 7 Plane, on the mountain above Greenville.

Stroudsburg, Pa.—It is stated that the people will soon vote on the construction of $40,000 works. The present works were built by a company in 1876.

Thompson, Pa.—The Thompson Water Co. has been incorporated: capital, $5,000.

Torresdale, Pa.—A pumping station and water tower, the latter 72 ft. high, will be built on the grounds of the Convent of the Sacred Heart.

SOUTHERN.

Asheville, N. C.—A new pump, force main and a 12,000,000-gall. reservoir are talked of.

Macon, Ga.—The Gas, Light & Water Co. proposes to increase its authorized capital stock from $500,000 to $1,000,000, and to use $300,000 for improvements to the gas- and water-works. The plan recommended for the proposed new city works includes a supply from the Ocomulgee River, filtered.

Savannah, Ga.—The Council has refused to ratify the award for pumps to the Holly Manufacturing Co. reported last week as made by the Water Committee, on the ground that the bid was received 35 minutes after the specified time.

NORTH CENTRAL.

Alliance, O.—It is reported that another water-works system is talked of.

Elwood, Ind.—The Elwood Water Co. has been incorporated; capital, $100,000.

Centralia, Ill.—There is now talk of a water company to build the proposed new works.

Chicago, Ill.—The Waukesha & Deep Rock Water Co. has been incorporated to pipe mineral water from Waukesha, Wis., to the city limits, from which point it will be distributed in wagons; capital stock, $1,000,000; incorporators, Calvin Goddard, F. W. Parsons, Benzette Williams and others.

Pontiac, Ill.—J. J. Hainsworth, Franklin, Ind., who has the franchise for works here, informs us that there will be a 15 × 125-ft. stand-pipe and five miles of mains; also that bids for materials will soon be wanted.

Springfield, Ill.—The Water Committee has been authorized to employ D. C. Cregier, Chicago, to report on an increased water supply. A new force main is under consideration.

NORTHWESTERN.

Mount Pleasant, Ia.—A press dispatch states that there has been trouble between the town and company and that the superintendent has notified the town that the works will be shut down Aug. 1. There is talk of the purchase of the works by the town and it is thought that the company is trying to hasten a settlement of difficulties.

Winnebago City, Minn.—Bids will be received by the Council until Aug. 17 for works, including a pump and two miles of mains, with hydrants and specials. W. Z. Haight is Mayor.

Deadwood, S. Dak.—We are informed that the time for opening bids for city water bonds has been extended until Aug. 3. A new water supply and mains throughout the part of the city not now supplied is contemplated, but no definite action has yet been taken. The present supply is furnished by the Homestake Mining Co.

Castle, Mont.—We are informed that gravity works will be built at once by a company at an estimated cost of from $48,000 to $60,000. Address James King, Helena, or H. H. Barns, Castle. Population, 2,500.

SOUTHWESTERN.

Honey Grove, Tex.—The Honey Grove Artesian Water Co. has been incorporated by W. D. Wilkins and others; capital, $20,000.

Quanah, Tex.—The Council has received an offer from a company to build water-works, electric light and ice plants.

Antonito, Col.—S. W. Hatch, Clerk, informs us that the town has not yet been able to sell its water bonds, and hence has not begun to build works.

Raton, N. M.—The Council has granted a franchise for works, the present supply being a development of the railway supply and now inadequate. The people will vote on the franchise Aug. 1.

PACIFIC.

Mount Vernon, Wash.—J. N. Turner has applied for a franchise to put in works estimated to cost $40,000, the same to be completed by Jan. 1, 1892.

Seattle, Wash.—The following is from F. W. D. Holbrook, Secretary Board Public Works:

Bids have been asked from all leading manufacturers for a 5,000,000-gall. pumping engine. Eventually a gravity supply will be secured from Cedar River, 25 to 30 miles distant.

Snohomish, Wash.—T. E. Marks, City Clerk, informs us that the issuance of water bonds for works estimated to cost $52,000 will be voted on Aug. 25. Proposed supply, river, pumping to reservoir.

Spokane Falls, Wash.—Oscar Huber, City Engineer, has sent the following:

The supply for the new works to be built by the city will probably be obtained from a large spring, seven miles distant. There will be a large reservoir and a 400,000-gall. stand-pipe.

San Francisco, Cal.—The Spring Valley Water Co. desires permission to build a reservoir on Seventh Ave., near Golden Gate Park, with a capacity of 35,000,000 galls., and a water surface about 360 ft. above city datum. The proposed dimensions are 320 × 930 ft. × 35 ft. deep. A dam is proposed, and the plan is to line the slopes and bottom with clay and concrete.

Santa Rosa, Cal.—Direct-pumping city works are under consideration. The present works were built by a company in 1873.

Yuma, Ariz.—The Council has accepted a proposition for a water supply to be furnished by the Yuma Pumping & Irrigating Co.

CANADA.

Essex, Ont.—Bids for building works will be received until Aug. 12 by John Milne, Mayor. John Galt, Toronto, is Consulting Engineer.

Toronto, Ont.—The Lieutenant-Governor has approved the by-law authorizing the city to borrow $184,723 for the extension of mains and for meters.

Wiarton, Ont.—T. D. Galloway, Clerk, informs us that a vote on the extension of the works at an estimated cost of $5,000 will soon be taken, and contracts probably let the middle of August.

ARTESIAN WELLS.

Conway, S. C.—A well has been proposed. Address G. A. Croft.

Paragould, Ark.—The Paragould Oil, Gas & Water Co. has been incorporated; capital, $3,000, of which $115 is paid in. L. C. Thompson, Treasurer.

Texas.—Wells are projected at Belcherville, Belton and Honey Grove. The Belton well will be sunk by the Belton Artesian Well Co.

IRRIGATION.

Carbon County, Wyo.—A. J. Bothwell, J. C. Davis and S. Brodt, of Rawlins, have proposed to incorporate under the name of Elk Mountain Land & Water Co., to construct large irrigating works. The land to be irrigated lies on the east side of the Platte River, between Bush and Pass Creeks.

Great Falls, Mont.—It is reported that Holden, Anderson & Lund have been awarded the contract for constructing 14 miles of irrigating canal for the Cascade Land Co., the work to be finished by the last of October.

Folsom, Cal.—The Natoma Water & Mining Co. proposes to build canals in a south and southeasterly direction, taking water from the American River.

New Companies.—Orkalon Irrigation & Water Power Co., Orkalon, Kan.; $15,000. Fort Belknap Canal & Irrigation Co., Chinook, Mont.; $20,000; Thomas O'Hanlon, J. V. Bogy and others. Sun River Water Power & Canal Co., Great Falls, Mont.; constructing ditch for irrigating and milling purposes. Poso Land, Water & Improvement Co., Delano, Kern Co., Cal.; $2,500,000; A. F. Dyer, G. L. Withers and others. Vernon Irrigation Co., Vernon, Cal.; $1,000,000, of which $67,000 is paid in; H. M. Ames, George Hanna and others. The Great Western Canal Construction Co., Chicago, Ill.; $100,000; to construct canals for irrigating, mining and milling purposes in Bingham Co., Idaho.

SEWERAGE AND MUNICIPAL.

Sewers.—*Massachusetts.*—Fitchburg. The city will allow Asher F. Black to set up and operate a machine for treating sewage.—Lawrence. Petitions have been made for sewers on several streets.—Salem. A 46-in. sewer, estimated to cost $18 000, has been recommended.

New York.—Goshen. A petition for a sewerage system is being circulated.—Port Jervis. Sewer bonds to the amount of $50,000 have been sold.

New Jersey.—Morristown. A proposition for a sewerage system made by the Sanitary Sewer & Sewage Utility Co., New York, has been referred to the Street Committee.—Plainfield. This city and the townships of Fanwood, Westfield, Cranford and possibly Roselle and Linden may combine to build a trunk sewer to Staten Island Sound.

Florida.—Tallapoosa. Propositions to construct a system have been made by New York parties.

Michigan.—Ypsilanti. The city has been divided into two districts and a committee appointed to receive bids for putting in sewers.

Montana.—Missoula. Bids will be asked for the construction of sewers in several streets.

Colorado.—Denver. Sewers have been recommended in several streets, over 1½ miles of 12- to 24-in. pipe and about one-half mile of 2½- to 4-ft. brick.

California.—Haywards. Sewers are being discussed and a sewage farm is talked of.

Canada.—London, Ont. A report on a sewage farm has been made by Willis Chipman, Toronto; estimated cost, $90,000.

Streets.—*Massachusetts.*—New Bedford. Petitions for paving a large number of streets have been made. An appropriation of $50,000 has been requested.

New York.—Buffalo. Seneca St. will be paved with block stone.

North Carolina.—Asheville. All bids for paving have been rejected and new bids will be asked.

Georgia.—Atlanta. The sum of $12,000 has been appropriated to pave Walker St.

Iowa.—Oskaloosa. About $40,000 will be expended for brick paving.

ELECTRICAL.

Electric Light.—New plants or extensions of those already existing are reported as probable in the following places: Suisun, Cal.; Quanah, Tex.; Louisville, Ky., address A. Barth; Franklin, Va., address W. W. Moore; Hillsboro, Tex.; Wheeling, W. Va., address N. E. Whitaker; Connellton, Ind.; Ishpeming, Mich.; Plymouth, N. H., address M. A. Ferrin; Le Roy, Fla.; Stamford, N. Y.; Pioche, Nev.

Schenectady, N. Y.—Bids for street lighting are wanted.

Orange, N. J.—It is reported that the Essex County Electric Co. will erect a central station to supply all their circuits. The building will be supplied with 20 generators of 40 to 50 H. P., driven by three 100-H. P. Ball engines. When completed the plant will have a capacity of 1,440 arc or 16,000 incandescent lamps, and will cost about $175,000.

Wheeling, W. Va.—The contract for furnishing the machinery for the municipal plant has been awarded to the Fort Wayne Electric Co. at $85,420, which includes the cost of six 80-light dynamos, Hamilton-Corliss engines, clutch pulleys, shafting, etc. This will be the largest municipal plant in the country when completed, and the competition to furnish the apparatus has been great.

Graniteville, S. C.—The Carolina Light & Power Co. has absorbed the Cotton Shoals Electric Light Co., and will erect a plant at Cotton Shoals, near this place.

Grand Rapids, Mich.—The City Council has voted to adopt the tower system of lighting. A contract for 41 towers 150 ft. high, with 4 lights each, and 86 single lights, was awarded the Star Iron Tower Co., of Fort Wayne, Ind., for $36,000 a year, the new system to be ready in 90 days.

New Companies.—Electrical Engineering Co., Chicago, Ill.; capital stock, $50,000; incorporators, R. H. Pierce, G. W. Seymour, F. K. Baggs. Light, Heat & Power Co., New Albany, Ind.; capital stock, $50,000. Merchants' Electric Light Co., Leavenworth, Kan.; capital stock, $50,000. Cutter Electrical & Mfg. Co., Camden, N. J.; capital stock, $100,000. Citizens' Light & Power Co., Seattle, Wash.; capital stock, $50,000; incorporators, A. E. Braymer, W. H. White, R. W. Emmons. Penacook Electric Lighting Co., Concord, N., H.; capital stock, $10,000; incorporators, C. H. Landers, E. H. Brown, G. W. Abbott and others.

CONTRACTING.

Pipe Specials and Pipe-laying.—*St. Louis, Mo.*—The contract for 640 tons of 12 and 6-in. cast-iron pipe was awarded, on July 24, to the Shickle, Harrison & Howard Iron Co., St. Louis, at $26.75 per ton; for 15 tons special castings, same firm, $54.50; for laying 11,500 ft. of 12-in. cast-iron mains, to W. W. Penny Surveying Co., at 23 cts per lin. ft.; laying 6-in. pipe, 20 cts; setting 8 fire plugs, $10 each; furnishing 300 lbs. wrought iron, 7 cts. per lb., to the same firm.

St. Louis, Mo.—The contract for section H of the low-service water-works conduit was awarded on July 24 to the Fruin-Bambrick Construction Co., as follows: Earth excavation, 13,000 cu. yds., at 25 cts.; borrowed earth, 1,500 cu. yds., do.; concrete, 3,700 cu. yds., $5.90; brick masonry, 2,200 cu. yds., $8.75; granitoid, 185,000 sq. ft., 20 cts.; 36-in. cast-iron pipe culvert, 100 lin. ft., $2.50; total amount, $48,655.

Macadamizing.—*Dunkirk, N. Y.*—The contract for macadamizing West Fourth St. from Central Ave. to the Brigham Road has been awarded to G. M. Newton, Dunkirk, as follows: Excavations, 30 cts. per cu. yd.; pavement, $1.11 per sq. yd.; curbing, 45 cts. per lin. ft.; circular, 65 cts.; reset, 10 cts.; stone crosswalks, 51 cts. per sq. yd.; relaid, 10 cts.; drain tile, 7 cts. per lin. ft.

Sewers.—*Kansas City, Mo.*—The contract for the construction of the third ½-mile section of the O. K. Creek sewer has been awarded to Martin Walsh, the lowest bidder, for $86,394. Six other bids were considered, ranging from $86 594 to $118,317.

Sewers.—*Lawrence, Kan.*—The following bids for the construction of pipe sewers were received July 20:

Size.	Length	Depth.	Bidders. H. I. Cook, Topeka.	T. J. Rosin, Topeka.	Lawrence Plumbing Co.
ins.	ft.	ft.	cts.	cts.	cts.
8	654	15	57*	61	64
"	1,334	13			48*
"	1,306	12	54*	56	55
"	1,334	12	49*	54½	59
"	1,306	9	51*	54	65
"	490	11	47*	54	47½
"	1,306	12	52*	54	65
"	640	12	48*	55	54
"	640	10	47	52	45*
12	580	10	61*	65	64½
Flush tank (without siphon).....			$35*	$34	$40
Manhole (10 ft.).....			$20*	$33	$40

* Awarded contract.

PROPOSALS OPEN.

Sewers.—*Cleveland, O.*—Building sewers in five streets. R. R. Herrick, Director of Public Works. Aug. 12.

Springfield, Mo.—Constructing sewerage system after plans by Nier & Hartford. C. P. Johnson, City Engineer. Aug. 11.

Streets.—*Brooklyn, N. Y.*—Grading and paving in four streets. J. P. Adams, Commissioner Public Works Aug. 3.

Rochester, N. Y.—Street improvements, cement and plank walks, sewer. Executive Board. Aug. 7.

Cleveland, O.—Grading, draining, curbing, on Willson Ave. and Sibley St., paving the former with dressed block Medina stone and the latter with brick; also paving with Medina stone on Woodland Ave. R. R. Herrick, Director Public Works. Aug. 5.

Pipe-laying.—*Danville, Pa.*—About 10,000 ft. 16-in iron pipe. S. S. Schultz, M. D., Superintendent. Aug. 3.

Dredging.—*Boston, Mass.*—Dredging 10,000 cu. yds., Chatham Harbor, Mass.

Lighthouse.—*Portland, Ore.*—Constructing Umpqua River lighthouse. T. H. Handbury, Major of Engineers, U. S. A., Lighthouse Engineer. Aug. 13.

MANUFACTURING AND TECHNICAL.

Cars.—The construction of 100 30-ton coal cars was recently started by the Roanoke (Va.) Machine Works. A total of 350 of these cars will be made on one order.

The Cook Locomotive Works, Paterson, N. J., have resumed work, and are building engines for Western roads.

The Nye Steam Vacuum Pump Co., of Chicago, Ill., is making three pumps for the Hapman Sand Co., Troy Grove, Ill., two with a capacity of 1,000 galls. per minute, one 500 galls. per minute. They also have orders for several other pumps of 500 galls. per minute capacity.

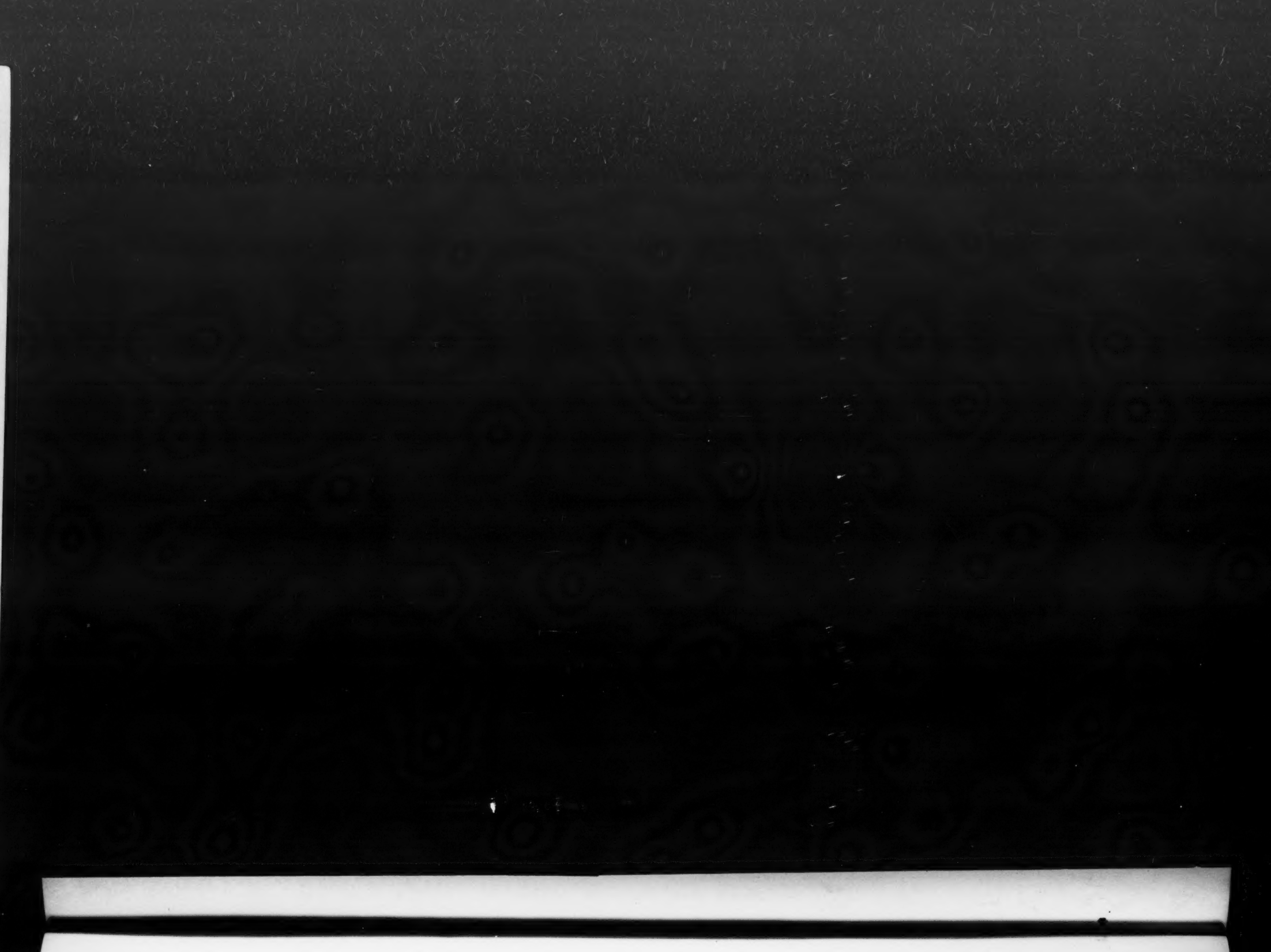
New Companies.—Wrought Steel Wheel Co., incorporated in New Jersey by W. P. Shinn, Pittsburg, Pa.; J. W. Roach, Camden, N. J., and others; $2,000,000. Commercial Gas, Light & Fuel Co., Trenton, N. J., to manufacture fuel and illuminating gas; S. W. Syckel, Hopewell, N. J., J. W. Hartpence, Newark; $100,000.

Metal Market Prices.—*Rails.*—New York: $30.75 to $31; old rails, $21.50 for iron and $17 for steel. Pittsburg: $30; old rails, $22.50 to $23 for iron and $17.50 to $18.50 for steel. Chicago: $31.50 to $33; old rails, $23 to $23.50 for iron and $14 to $16.50 for steel.

Track Materials.—New York: steel angle bars, 1.75 to 1.8 cts.; spikes, 2.15 to 2.25 cts.; track bolts, 2.7 to 2.8 cts. Pittsburg: splice bars, 1.8 to 1.9 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.75 cts. with square and 2.85 cts. with hexagon nuts. Chicago: splice bars, 1.8 to 1.9 cts. for iron, 2 cts. for steel; spikes, 2 2 to 2.25 cts.; track bolts, 2.8 cts. with hexagon nuts.

Foundry Pig Iron.—New York: $14 to $18. Pittsburg: $14.75 to $16.75. Chicago: $14.50 to $16.

Pipe.—Cast iron, $25 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 55 and 45 per cent. on black and galvanized butt-welded; 65 and 52½ on black and galvanized lap-welded. Casing, 55 per cent.

Lead.—New York: 4.4 to 4.5 cts. Chicago: 4.25 to 4.3 cts. St. Louis: 4.2 to 4.22½ cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 1.95 to 2.1 cts.; tees, 2.45 to 2.75 cts.; sheared iron plates, 1.95 to 2.25 cts.; steel plates, 2 to 2.15 cts. for tank, 2.3 to 2.6 cts. for shell, 2.5 to 2.7 cts for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams 3.1 cts.; channels, 3.1 cts.; angles, 2 cts.; tees, 2.6 cts.; universal iron mill plates, 2.05 cts.; sheared steel bridge plates, 2.1 to 2.15 cts.; refined bars, 1.8 to 1.85 cts.; steel plates, 2.1 cts. for tank, 2.35 cts. for shell, 2.55 cts. for flange, 3.9 to 4.25 cts. for firebox. Chicago: beams, 3.2 cts.; channels, 3.2 cts.; angles, 2.1 to 2.2 cts.; tees, 2.6 to 2.7 cts.; universal plates, 2.15 to 2.2 cts.; sheared plates, 2.25 to 2.35 cts. for iron; steel plates, 2.4 to 2.6 cts. for tank, 2.85 to 3 cts. for shell, 3 to 3.25 cts. for flange; 4.5 to 5.5 cts. for firebox; boiler rivets, 4.25 cts.